Vol. XXXIX. FEBRUARY, 1913. No. 2.

AMERICAN SOCIETY OF CIVIL ENGINEERS

INSTITUTED 1852

PROCEEDINGS

This Society is not responsible for any statement made or opinion expressed in its publications.

SOCIETY AFFAIRS

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MINUTES OF MEETINGS OF THE SOCIETY

SIXTIETH ANNUAL MEETING*

January 15th, 1913.—The meeting was called to order at 10 A. M.; President John A. Ockerson in the chair; Charles Warren Hunt, Secretary; and present, also, about 400 members.

Messrs. C. A. Tinker, W. F. Strouse, W. M. Kinney, and E. G. Kastenhuber, Jr., were appointed Tellers to canvass the Ballot for Officers for the ensuing year.

The Annual Report of the Board of Direction, and the Annual Reports of the Secretary and of the Treasurer,† for the year ending December 31st, 1912, were presented and accepted.

* A full report of the Sixtieth Annual Meeting is printed on pages 68 to 102 of this number of *Proceedings*.

† For these reports, see pages 10 to 20 of *Proceedings* for January, 1913 (Vol. XXXIX).

The Secretary presented the report* of the Board of Direction awarding the prizes for the year ending July, 1912, in accordance with the report of the Committee to Recommend the Award of Prizes, as follows:

The Norman Medal to Paper No. 1212, "The Detroit River Tunnel," by Wilson Sherman Kinnear, M. Am. Soc. C. E.

The Thomas Fitch Rowland Prize to Paper No. 1210, "Reinforced Concrete Bridge Across the Almendares River, Havana Cuba," by Eugene Klapp and W. J. Douglas, Members, Am. Soc. C. E.

The Collingwood Prize for Juniors to Paper No. 1213, "A Reinforced Concrete Stand-Pipe," by W. W. Clifford, Jun. Am. Soc. C. E.

The following were appointed members of the Nominating Committee to serve two years:

S. W. Hoag, Jr.	*Representing*	*District*	*No.*	*1*
Charles T. Main	"	"	"	*2*
E. A. Fisher	"	"	"	*3*
Richard Khuen	"	"	"	*4*
J. B. Berry	"	"	"	*5*
Frank M. Kerr	"	"	"	*6*
William Mulholland	"	"	"	*7*

A Progress Report of the Special Committee on Concrete and Reinforced Concrete was presented by Richard L. Humphrey, M. Am. Soc. C. E., Secretary of that Committee.†

The report was accepted and the committee continued.

Desmond FitzGerald, Past-President, Am. Soc. C. E., Chairman of the Special Committee on Engineering Education, presented a Progress Report of that Committee.‡

The report was accepted and the committee continued.

Austin L. Bowman, M. Am. Soc. C. E., Chairman of the Special Committee on Steel Columns and Struts, presented a Progress Report of that Committee.§

The report was accepted and the committee continued.

A. H. Blanchard, M. Am. Soc. C. E., Secretary of the Special Committee on Bituminous Materials for Road Construction, presented a Progress Report of that Committee.‖

The report was accepted and the committee continued.

Frederic P. Stearns, Past-President, Am. Soc. C. E., Chairman of the Special Committee on the Valuation of Public Utilities, presented a Progress Report of that Committee.¶

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* See page 69.
† See page 117.
‡ See page 169.
§ See page 170.
‖ See page 175.
¶ See page 176.

The report was accepted and the committee continued.

The Secretary reported that the Board of Direction had appointed a Special Committee to Investigate the Conditions of Employment of, and Compensation of, Civil Engineers, consisting of Alfred Noble, Chairman; S. L. F. Deyo, Dugald C. Jackson, William V. Judson, George W. Tillson, C. F. Loweth, and John A. Bensel.

The Secretary reported that the Board of Direction had decided to appoint a Special Committee of seven to Codify Present Practice on the Bearing Value of Soils for Foundations, etc., but that, as yet, the committee had not been completed.

The Secretary presented a report from the Board of Direction in reference to a proposed amendment to the Constitution, dividing the territory occupied by the membership into thirteen geographical districts, instead of the seven which are now prescribed.*

It was moved, seconded, and carried "That the recommendation of the Board be approved."

It was moved, seconded, and carried "That it is the sense of this Meeting that a change as outlined by the report read by the Secretary is desirable; that the Board, in reporting back such an amendment to the Society, remove the restriction as to State and Territorial lines."

It was moved, seconded, and carried "That the whole matter be referred back to the Board of Direction, with request that they prepare what they consider a suitable amendment in consideration of the discussion we have had here to-day, in time to be acted upon by the next Convention."

The Secretary presented a letter from E. W. Clarke, M. Am. Soc. C. E., offering the following resolution:

"That the President appoint a committee of five to investigate and report at the regular business meeting in March, 1913, on the possibility of securing suitable engineering entertainments to take the place of the reading of the formal papers for the semi-monthly meetings."

It was moved, seconded, and carried "That a committee of five be appointed to consider and report upon an improvement of the methods of the presentation of papers before the Society."

The Secretary read a letter from Percival M. Churchill, Assoc. M. Am. Soc. C. E., offering the following resolution:

"*Moved:* That the Board of Direction be instructed to confer with the officers of the Am. Institute of Consulting Engineers, the Am. Soc. of Mechanical Engineers, the Am. Institute of Electrical Engineers, and of any other Engineering Society it deems proper to include, for the purpose of ascertaining if these Societies will join with us in appointing a joint Committee to draw up a plan for the establishment and operation of an Exchange for the Marketing of Engineering

* See page 77.

Services of every sort. The Board of Direction to be authorized and instructed to appoint the Committee from this Society as soon as any of the other Societies signify their willingness to join in the work."

On motion, duly seconded, Mr. Churchill's resolution was referred to the Board of Direction.

The Secretary read another letter from Mr. Churchill proposing the following resolution:

"*Moved:* That this Society shall consider the adoption of a Code of Ethics for Engineers recently proposed by a Committee of the American Society of Mechanical Engineers and published in *Engineering News,* January 2d, 1913.

"That the proposed Code be printed as a letter ballot and submitted to the members of this Society, with the request that each member vote to accept or reject the Code article by article; that where a member so desires he shall—after voting against a certain article—submit a substitute in the form he desires that article to take. In the same manner additions may be presented.

"This ballot to be closed April 1st, 1913.

"The Board of Direction shall then send out a second ballot giving the Code as first proposed, and also any suggested changes and additions. Members shall vote article by article. The ballots to be opened at the next Annual Convention, and any article having a majority of the votes cast shall be declared adopted.

"The Code as thus adopted to be then printed in the *Proceedings* and the *Transactions* of the Society."

On motion, duly seconded, Mr. Churchill's resolution was referred to the Board of Direction.

The Secretary presented a report giving complete information as to the arrangements made thus far for the proposed International Engineering Congress to be held in San Francisco in 1915.*

H. M. Wilson, M. Am. Soc. C. E., offered the following motion:

"That the Board of Direction be and is hereby authorized to consider plans for increasing the capacity of the Society House to better accommodate the membership at the Annual Meetings."

The motion being duly seconded, was carried.

H. H. Quimby, M. Am. Soc. C. E., offered the following motion in reference to the acoustics of the Auditorium:

"That the Board of Direction be requested to employ the best talent that is available, and do something to make it more satisfactory to the hearers in this room and to the speakers also."

The motion, being duly seconded, was carried.

The Secretary presented the report of the Tellers appointed to canvass the Ballot for Officers for the ensuing year.

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* See page 97.

The President announced the election of the following officers:

President, to serve one year:

GEORGE F. SWAIN, Cambridge, Mass.

Vice-Presidents, to serve two years:

J. WALDO SMITH, New York City.
CHARLES H. RUST, Victoria, B. C., Canada.

Treasurer, to serve one year:

JOHN F. WALLACE, New York City.

Directors, to serve three years:

HENRY W. HODGE, New York City.
JAMES H. EDWARDS, Passaic, N. J.
LEONARD METCALF, Boston, Mass.
HENRY R. LEONARD, Philadelphia, Pa.
EDWARD H. CONNOR, Leavenworth, Kans.
SAMUEL H. HEDGES, Seattle, Wash.

Mr. Stearns and Mr. Noble conducted Mr. Swain, the President-elect, to the chair.

Mr. Swain addressed the meeting briefly.

Adjourned.

SPECIAL MEETINGS FOR TOPICAL DISCUSSION ON ROAD CONSTRUCTION AND MAINTENANCE.

January 17th, 1913.—The first special meeting for topical discussion on "Road Construction and Maintenance" was called to order at 10 A. M.; President George F. Swain in the chair; Charles Warren Hunt, Secretary; and present, also, 140 members and guests.

The Secretary announced that Arthur H. Blanchard, M. Am. Soc. C. E., would act as Secretary.

In the absence of Paul McLoud, M. Am. Soc. C. E., who was to have introduced the discussion on the first topic, "Cement-Concrete Pavements," the opening remarks were made by J. A. Johnston, M. Am. Soc. C. E. The topic was discussed further by Messrs. Sanford E. Thompson, W. A. McIntyre, W. M. Kinney, Charles W. Leavitt, Jr., E. H. Thomes, R. A. MacGregor, James Owen, Philip P. Sharples, L. P. Sibley, C. W. Ross, R. W. Lesley, Charles P. Price, S. Whinery, Harold Parker, W. P. Blair, W. A. Aiken, Percy H. Wilson, and Arthur H. Blanchard.

Adjourned.

January 17th, 1913.—The second special meeting was called to order at 2.30 P. M.; Harold Parker, M. Am. Soc. C. E., in the chair; Arthur H. Blanchard, acting as Secretary; and present, also, 130 members and guests.

The second topic for discussion, "Cost Records and Reports," was opened by Nelson P. Lewis, M. Am. Soc. C. E., who was followed by Messrs. L. L. Tribus, James Owen, W. W. Crosby, G. W. Tillson, W. H. Connell, Henry W. Durham, Fred. E. Ellis, W. H. Messenger, Harry C. Hill, and A. M. Willcock.

Owing to the absence of Jean L. de Pulligny, M. Am. Soc. C. E., who was to have presented the opening discussion on the third topic, "Design of Highway Systems," the subject was introduced by Col. William D. Sohier.* The topic was also discussed by Messrs. Bertram Brewer, Nelson P. Lewis, James Owen, Amos Schaeffer, J. W. Howard, Ira O. Baker, C. E. Carter, Arthur H. Blanchard, and F. O. Whitney.

Adjourned.

January 18th, 1913.—The third special meeting was called to order at 10 A. M.; W. W. Crosby, M. Am. Soc. C. E., in the chair; Arthur H. Blanchard acting as Secretary; and present, also, 130 members and guests.

Francis P. Smith, M. Am. Soc. C. E., introduced the fourth topic, "Equipment for the Construction of Bituminous Surfaces and Bituminous Pavements." The subject was discussed further by Messrs. Henry B. Drowne, Clifford Richardson, Carl E. Pelz, E. H. Thomes, Charles P. Price, Arthur H. Blanchard, W. H. Kershaw, James L. Gaynor, Henry C. Poore, R. L. Christie, W. S. Godwin, Walter H. Fulweiler, J. A. Johnston, J. W. Howard, S. J. Stewart, W. W. Crosby, Philip P. Sharples, A. S. Brainard, and Prevost Hubbard.

Adjourned.

REGULAR MEETING.

February 5th, 1913.—The meeting was called to order at 8.30 P. M.; Vice-President J. Waldo Smith in the chair; Charles Warren Hunt, Secretary; and present, also, 94 members and 13 guests.

The minutes of the meetings of December 18th, 1912, and January 8th, 1913, were approved as printed in *Proceedings* for January, 1913.

A paper by B. F. Groat, Assoc. M. Am. Soc. C. E., entitled "Characteristics of Cup and Screw Current Meters; Performance of These Meters in Tail-Races and Large Mountain Streams; Statistical Synthesis of Discharge Curves," was presented by the author and illustrated with lantern slides.

The Secretary read communications on the subject from Messrs. W. G. Price, E. E. Haskell, and Charles H. Miller, and the paper was

*Of the Massachusetts Highway Commission.

discussed orally by Messrs. J. C. Hoyt, C. W. Staniford, and the author.

A paper by John N. Brooks, Jun. Am. Soc. C. E., entitled "The Infiltration of Ground-Water into Sewers," was presented by title, but discussion was postponed until the next meeting of the Society, February 19th, 1913.

The Secretary announced the election of the following candidates on February 4th, 1913:

As Members

Joseph Marr Knight, Sedalia, Mo.
Walter Swain Nichols, Philadelphia, Pa.
Charles Lester Parmelee, New York City
William John Thomas, New York City
Max Wakeman Weir, Elba, N. Y.

As Associate Members

George Chester Britton, Hemlock, N. Y.
Charles Denton Conklin, Jr., Cheltenham, Pa.
Joseph Augustine Aloysius Connelly, New York City
Matthew Raymond Dinsmore, City of Mexico, Mexico
Louis Warren Duffee, Meridian, Miss.
Warren Clifford Earle, Portland, Ore.
Clarence Eugene Ellsworth, Washington, D. C.
Charles MacFarlane Finley, Sioux City, Iowa
Nicolay Knudtzon Fougner, Hongkong, China
Ernest Edmund Grimes, Juntura, Ore.
Thomas Felix Hickerson, Chapel Hill, N. C.
Alan Moore Edward Johnstone, New York City
Murray Kay, Hood River, Ore.
William Archibald Keene, Jr., Cotton Plant, Ark.
Fulton Lane, Los Angeles, Cal.
Ambrose Packard, Providence, R. I.
George Arthur Sampson, Brighton, Mass.
Harold Garfield Smith, Salt Lake City, Utah
Edward Smulski, Newton Highlands, Mass.
James Bigelow Steep, Indianapolis, Ind.
Henry William Taylor, Albany, N. Y.
Jent George Thorne, Clinton, Iowa
John Junior Wilson, Denver, Colo.

As Juniors

Clarence Myers Bates, Tacoma, Wash.
Frank Earle Dodge, Hudson, N. Y.
Edmond Anthony Fretz, Brooks, Alta., Canada
Johan Friedrich Wilhelm Gebhardt, Keokuk, Iowa

Peter Davidson Gunn Hamilton, Beverly, Mass.
Oliver Howard Lang, Atlanta, Ga.
Chester Sherman Lee, Cooperstown, N. Y.
Harold MacLean Lewis, Brooklyn, N. Y.
Maurice Paul O'Connor, New York City
John Fredrick Partridge, Stanford University, Cal.
Alvin Christian Rasmussen, Indianapolis, Ind.
William Stava, Coyote, Cal.
Harry Herman Steinhauser, Rochester, N. Y.
Percy Hixon Van Etten, Coyote, Cal.

The Secretary announced the transfer of the following candidates on February 4th, 1913:

From Associate Member to Member

Edward Everett Betts, Chattanooga, Tenn.
Harry Frank Cameron, Manila, Philippine Islands
Edward Walter Cunningham, Cleveland, Ohio
Wilton Joseph Darrow, New York City
Henry Roberts Hortenstine, Beaver Falls, Pa.
Jay Cowden Lathrop, Akron, Ohio
Ernest George Matheson, Coquitlam, B. C., Canada
Edward Emmet Sands, Calgary, Alta., Canada

From Junior to Associate Member

Ernest Delevan Cole, Concord, Cal.
Paul Max Entenmann, Brooklyn, N. Y.
Howard Foss Esten, Providence, R. I.
Henry James Gardner, Jr., Buffalo, N. Y.
Frank Gillelen, Los Angeles, Cal.
Frederick Nathaniel Hatch, New York City
Gordon Burnett Gifford Hull, Camargo, Chih., Mexico
Robert Louis Reimann-Hansen, Baltimore, Md.
Clarence Urling Smith, Chanhassen, Minn.
Charles Edwards Tirrell, Rochester, N. Y.
Royal Sylvester Webster, Havana, Cuba

From Junior to Associate

Alexander Allen MacVicar Russell, Oakland, Cal.

The Secretary announced the following deaths:

George Edward Gray, elected Member, July 2d, 1873; Honorary Member, June 5th, 1894; died January 1st, 1913.

William Gaston Hamilton, elected Member, October 7th, 1868; died January 23d, 1913.

Ebenezer Smith Wheeler, elected Member, November 7th, 1883; died January 5th, 1913.

CHARLES DE LA PLANE ATTERBURY, elected Associate Member, November 8th, 1909; died June 3d, 1912.

JOHN MACGREGOR, elected Associate, June 2d, 1903; died January 21st, 1913.

JAMES WATSON, elected Fellow, December 5th, 1872; died December, 1910.

Adjourned.

OF THE BOARD OF DIRECTION.

(Abstract)

January 7th, 1913.—President Ockerson in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Bush, Clarke, Endicott, Gerber, Knap, Loomis, Macdonald, Ridgway, Snow, and Thomson.

A report* on a proposed amendment to the Constitution, increasing the number of Geographical Districts into which the Society is divided for the purpose of the nomination and election of representative officers, was adopted for presentation to the Annual Meeting on January 15th.

The following report was received from the Committee appointed to Recommend the Award of Prizes for the year ending July, 1912:

"The Committee appointed by you to recommend the award of prizes to be made at the Annual Meeting in January, 1913, submits the following nominations:

"For the Norman Medal, Paper No. 1212, 'The Detroit River Tunnel.'

"For the Rowland Prize, Paper No. 1210, 'The Reinforced Concrete Bridge Across the Almendares River, Havana, Cuba.'

"For the Collingwood Prize for Juniors, Paper No. 1213, 'A Reinforced Concrete Stand-Pipe.'

"Yours truly,
"E. P. GOODRICH, *Chairman*,
"For the Committee."

On motion, duly seconded, the recommendations of the Committee were adopted, and the prizes were awarded as follows:

The Norman Medal to Paper No. 1212, "The Detroit River Tunnel," by Wilson Sherman Kinnear, M. Am. Soc. C. E.

The Thomas Fitch Rowland Prize to Paper No. 1210, "Reinforced Concrete Bridge Across the Almendares River, Havana, Cuba," by Eugene Klapp and W. J. Douglas, Members, Am. Soc. C. E.

The Collingwood Prize for Juniors to Paper No. 1213, "A Reinforced Concrete Stand-Pipe," by W. W. Clifford, Jun. Am. Soc. C. E.

The Secretary announced that the Special Committee appointed to Investigate the Condition of Employment of, and Compensa-

* See page 77.

tion of, Civil Engineers Throughout the Country, was now complete, all of the gentlemen appointed having accepted such appointment, and that the Committee is as follows: Alfred Noble, *Chairman*, S. L. F. Deyo, Dugald C. Jackson, William V. Judson, George W. Tillson, C. F. Loweth, and J. A. Bensel.

The proposal for the appointment of a Special Committee "To Codify Present Practice on the Bearing Value of Soils for Foundations, and Report upon the Physical Characteristics of Soils in Their Relation to Engineering Structures," which was referred to the Board of Direction by the Society, was considered, and the Board decided to appoint such Committee.

The payment of $10 000 on the mortgage debt of the Society as soon as possible was authorized.

The purchase of twenty bonds, at a par value of $1 000 each, was authorized, said bonds to be added to the Reserve Fund already established.

Action was taken in regard to members in arrears for dues.

The resignations of 3 Members, 14 Associate Members, 1 Associate, and 8 Juniors, were accepted.

Ballots for membership were canvassed, resulting in the election of 9 Members, 25 Associate Members, 2 Associates, and 14 Juniors, and the transfer of 7 Juniors to the grade of Associate Member, and 1 Junior to the grade of Associate.

Ten Associate Members were transferred to the grade of Member.

Applications were considered, and other routine business transacted.

Adjourned.

January 15th, 1913.—The Board met, as required by the Constitution, at the House of the Society during the Annual Meeting, January 15th, 1913, at 1.05 P. M.; President Swain in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Bates, Bensel, Bush, Cain, Churchill, Clarke, Connor, Edwards, Endicott, Hodge, Leonard, Macdonald, Metcalf, Ockerson, Ridgway, Smith, Snow, Staniford, Thomson, and Wallace.

The first business in order was the election of a Secretary.

Mr. Hunt retired.

Chas. Warren Hunt was nominated for Secretary and elected.

Mr. Hunt was recalled.

The following Standing Committees of the Board were appointed:

Finance Committee: Lincoln Bush, George C. Clarke, Henry W. Hodge, Leonard Metcalf, and Emil Gerber.

Publication Committee: James H. Edwards, Robert Ridgway, Chas. S. Churchill, William Cain, and Jonathan P. Snow.

Library Committee: J. Waldo Smith, Charles D. Marx, T. Kennard Thomson, E. C. Lewis, and Chas. Warren Hunt.

Adjourned.

February 4th, 1913.—President Swain in the chair; Chas. Warren Hunt, Secretary; and present, also, Messrs. Bush, Clarke, Edwards, Endicott, Hodge, Ridgway, Smith, Snow, Thomson, and Wallace.

It was resolved that no employee of the Society be permitted to accept fees or gratuities, and that a notice to this effect be conspicuously posted in the Society House.

It was resolved that all Reports of Special Committees intended for presentation to the Society at either of the two General Business Meetings shall be placed in the hands of the Secretary at least sixty days in advance of such meeting, and published in *Proceedings* in advance of their presentation for discussion.

The following Special Committee to Codify Present Practice on the Bearing Value of Soils for Foundations, and report upon the Physical Characteristics of Soils, in their relation to Engineering Structures, was appointed: Robert A. Cummings, Edward C. Shankland, Edwin Duryea, Jr., James C. Meem, Walter J. Douglas, Samuel T. Wagner, and Frank M. Kerr.

A Committee of five members of the Board was appointed to consider and report upon an improvement of the methods of the presentation of papers read before this Society.

A Committee was appointed to draw up an amendment to the Constitution covering the proposed re-districting of the Society, on the lines indicated by the report of the Board to the Annual Meeting, and the discussion of the subject at that meeting.

Messrs. Charles D. Marx, William A. Cattell, Arthur L. Adams, and Charles Derleth, Jr., were appointed to serve, with the President and Secretary of the Society, as the representatives of this Society on a General Committee which is to have entire charge of the organization and carrying out of the proposed International Engineering Congress to be held in connection with the Panama-Pacific Exposition in 1915.

Ballots for membership were canvassed, resulting in the election of 5 Members, 23 Associate Members, and 14 Juniors, and the transfer of 11 Juniors to the grade of Associate Member, and 1 Junior to the grade of Associate.

Eight Associate Members were transferred to the grade of Member.

Applications were considered and other routine business transacted.

Adjourned.

REPORT IN FULL OF THE SIXTIETH ANNUAL MEETING, JANUARY 15TH AND 16TH, 1913.

Wednesday, January 15th, 1913 (10 A. M.)—John A. Ockerson, President, in the chair; Charles Warren Hunt, Secretary; and present, also, about 400 members.

Meeting called to order.

THE PRESIDENT.—The meeting will please come to order. This is the Sixtieth Annual Meeting of the American Society of Civil Engineers. The ballot for officers was closed at nine o'clock and the following tellers have been appointed: C. A. Tinker, W. F. Strouse, W. M. Kinney, E. G. Kastenhuber, Jr.

Tellers Appointed.

The next thing in order is the report of the Board of Direction.

Report of the Board of Direction.

The Secretary presented the Report of the Board of Direction.*

THE PRESIDENT.—If there are no objections, the report of the Board will be received and printed. There appear to be no objections. The report of the Secretary is next.

Report of the Secretary.

The Secretary presented his Report† of receipts and disbursements for the year, including a general balance sheet showing the financial condition of the Society.‡

THE PRESIDENT.—If there are no objections, the report of the Secretary will be received and printed as read.

Report of the Treasurer.

The report of the Treasurer.

JOSEPH M. KNAP, TREASURER, AM. SOC. C. E.—Mr. President and gentlemen, there is very little left for the Treasurer after the very full reports of the Secretary and the Board of Direction, but the Constitution requires that the Treasurer shall make a report at the end of the year, which is as follows:

The Treasurer read his report.§

Mr. President and gentlemen, I want to add a little to my usual formal report. In this, my last report as Treasurer of the American Society of Civil Engineers, I may be pardoned for elaborating the formal report by showing the steady and rapid increase in our cash, available assets, and cash investments, from the year 1900 to the present time. On December 31st, 1900, the balance sheet showed as follows:

Building and lots (cost)		$191 730.26
Due from members, etc		3 372.74
Cash on hand		9 929.82
Making a total of		$205 032.82
Deducting dues paid in advance	$9 528.03	
And mortgage deed at that time	75 000.00	
		84 528.03
We have		$120 504.79

* See *Proceedings*, Am. Soc. C. E., Vol. XXXIX, p. 10 (January, 1913).
† See *Proceedings*, Am. Soc. C. E., Vol. XXXIX, p. 18 (January, 1913).
‡ See *Proceedings*, Am. Soc. C. E., Vol. XXXIX, p. 17 (January, 1913).
§ See *Proceedings*, Am. Soc. C. E., Vol. XXXIX, p. 20 (January, 1913).

This is cash invested and on hand, and takes no account of any appreciation or depreciation of any real estate or property.

On December 31st, 1912, the corresponding items were:

Lots (cost)	$189 632.11	
House (cost)	170 955.59	
		$360 587.70
Invested in bonds		57 441.25
Due from members, etc		10 745.84
Cash on hand		44 074.04
		$472 848.83
Deducting dues in advance	$28 107.55	
Mortgage debt	115 000.00	
		143 107.55
Balance		$329 741.28

That is the amount of cash invested and on hand, but without any account of any appreciation in the value of the property. This is the amount actually earned, I might say, or saved during the twelve years, without taking into account the enhanced value of our property, which, as the report of the Board of Direction shows, has been very great.

Another point to which I would call your attention is the present mortgage of $115 000, which will be, or already has been, reduced to $105 000, and the reserve fund increased to $77 000. With the same rate of progress during the current year, the lines of our bonded debt and reserve fund will have crossed, so that the entire mortgage can be paid, leaving a cash balance in hand, during the present year. Whether that would be the best policy will be for the incoming Board to decide, but it would be indeed a great satisfaction for the Society to feel that all debts have been paid and an accumulation of a new reserve fund begun.

THE PRESIDENT.—Gentlemen, you have heard the report of the Treasurer. If there are no objections, it will be received and printed as read. The next in order is the report on the award of prizes.

REPORT OF THE BOARD OF DIRECTION IN THE MATTER OF THE AWARD OF PRIZES FOR THE YEAR ENDING JULY, 1912.

Award of Prizes.

The Committee appointed to Recommend the Award of Prizes consisted of Messrs. E. P. Goodrich, Gardner S. Williams, and J. W. Woermann. This Committee reported to the Board of Direction, and the Board, in accordance with the Constitution, has awarded the prizes in accordance with the recommendations of the Committee as follows:

The Norman Medal.—Paper No. 1212, "The Detroit River Tunnel," by Wilson Sherman Kinnear, M. Am. Soc. C. E.

Award of Prizes (continued).

The Thomas Fitch Rowland Prize.—Paper No. 1210, "Reinforced Concrete Bridge Across the Almendares River, Havana, Cuba," by Eugene Klapp and W. J. Douglas, Members, Am. Soc. C. E.

The Collingwood Prize for Juniors.—Paper No. 1213, "A Reinforced Concrete Stand-Pipe," by W. W. Clifford, Jun. Am. Soc. C. E.

By order of the Board of Direction,

CHAS. WARREN HUNT,
Secretary.

JANUARY 7TH, 1913.

Nominating Committee.

THE PRESIDENT.—The next in order is the appointment of the members of the Nominating Committee.

THE SECRETARY.—I beg leave to report a count of the final suggestions from members in the several districts expressing their choice for the member of the Nominating Committee to be appointed from each, as follows:

District No. 1: Total number of suggestions received, 379, as follows:

S. W. HOAG, JR.	187
RUDOLPH P. MILLER	139
S. H. WOODARD	51
GEORGE A. HARWOOD	1
C. V. V. POWERS	1

THE PRESIDENT.—Gentlemen, you have heard the names suggested for member of the Nominating Committee for District No. 1. What is your pleasure?

G. W. TILLSON, M. AM. SOC. C. E.—Mr. President, I move that as Mr. S. W. Hoag, Jr., has received the largest number of votes, he be declared member of the Nominating Committee from District No. 1.

(Motion duly seconded.)

THE PRESIDENT.—It is moved and seconded that S. W. Hoag, Jr., be the member of the Nominating Committee from the First District. As many as are in favor of that will signify it by saying "aye"; contrary, "no". Carried.

THE SECRETARY.—District No. 2: Total number of suggestions received, 169, as follows:

CHARLES T. MAIN	82
C. M. SPOFFORD	64
JOHN E. HILL	18
J. W. ROLLINS, JR.	2
A. C. DENNIS	1
JOHN KENNEDY	1
H. N. RUTTAN	1

THE PRESIDENT.—What is your pleasure, gentlemen?

A MEMBER.—Mr. President, I move that Charles T. Main, having received the largest number of votes, be made the member for District No. 2.

(Motion duly seconded.)

THE PRESIDENT.—It is moved and seconded that Charles T. Main be selected as member of the Nominating Committee from District No. 2. As many as are in favor of that will signify it by saying "aye"; contrary, "no". It is so ordered.

THE SECRETARY.—District No. 3: Total number of suggestions received, 202, as follows:

E. A. FISHER	81
ENRIQUE A. TOUCEDA	62
WILLIAM H. YATES	56
GEORGE H. FENKELL	1
LOUIS H. KNAPP	1
MORRIS R. SHERRERD	1

G. S. WILLIAMS, M. AM. SOC. C. E.—Mr. President, I move that E. A. Fisher, having received the highest number of votes for District No. 3, be declared the member of the Nominating Committee from that district.

(Motion duly seconded.)

THE PRESIDENT.—It is moved and seconded that E. A. Fisher be declared the member of the Nominating Committee for District No. 3. As many as are in favor of that will signify by saying "aye"; contrary, "no". Carried.

THE SECRETARY.—District No. 4: Total number of suggestions received, 265, as follows:

RICHARD KHUEN	151
FRANK SUTTON	65
E. K. MORSE	47
RICHARD L. HUMPHREY	1
MORRIS KNOWLES	1

N. P. LEWIS, M. AM. SOC. C. E.—Mr. President, I move that Richard Khuen, having received the highest number of votes, be declared member of the Nominating Committee for District No. 4.

(Motion duly seconded.)

THE PRESIDENT.—Gentlemen, it has been moved and seconded that Richard Khuen be declared member of the Nominating Committee for District No. 4. All in favor of the motion signify by saying "aye"; contrary, "no". It is so ordered.

Nominating Committee (continued).

THE SECRETARY.—District No. 5: Total number of suggestions received, 181, as follows:

J. B. BERRY	68
J. V. HANNA	58
J. M. JOHNSON	28
E. H. LEE	25
WILLIAM G. RAYMOND	1
EDWARD E. WALL	1

MR. G. S. WILLIAMS.—Mr. President, I move that J. B. Berry, having received the highest number of votes, be declared the nominee for District No. 5.

(Motion duly seconded.)

THE PRESIDENT.—It has been moved and seconded that J. B. Berry be selected as member of the Nominating Committee for District No. 5. As many as are in favor signify by saying "aye"; contrary, "no". It is so ordered.

THE SECRETARY.—District No. 6: Total number of suggestions received, 180, as follows:

FRANK M. KERR	63
T. U. TAYLOR	41
B. M. HALL	40
J. F. COLEMAN	24
CHARLES C. WENTWORTH	2
M. J. CAPLES	1
LOUIS C. HILL	1
E. H. LEE*	1
RICHARD MONTFORT	1
MAURY NICHOLSON	1
ARSÈNE PERRILLIAT	1
ARTHUR PEW	1
J. S. SEWELL	1
G. R. SOLOMON	1
NISBET WINGFIELD	1

THE PRESIDENT.—What is your pleasure, gentlemen?

MR. N. P. LEWIS.—Mr. President, I move that Frank M. Kerr, having received the largest number of votes, be declared member of the Nominating Committee for District No. 6.

(Motion duly seconded.)

THE PRESIDENT.—It is moved and seconded that Frank M. Kerr be declared a member of the Nominating Committee for District No. 6. As many as are in favor signify by saying "aye"; contrary, "no". It is so ordered.

*Mr. Lee is ineligible, as he does not reside in this district.

THE SECRETARY.—District No. 7: Total number of suggestions received, 298, as follows:

WILLIAM MULHOLLAND	147
D. D. CLARKE	89
H. N. SAVAGE	52
J. D. GALLOWAY	1
SAMUEL H. HEDGES	1
D. C. HENNY	1
F. C. HORN	1
F. H. JOYNER	1
J. B. LIPPINCOTT	1
CHARLES D. MARX	1
EMERY OLIVER	1
W. J. ROBERTS	1
A. J. WILEY	1

THE PRESIDENT.—Gentlemen, William Mulholland apparently has received the largest number of votes. As many as are in favor of declaring Mr. Mulholland the member of the Nominating Committee for District No. 7 signify by saying "aye"; contrary, "no". It is so ordered.

Report of Committee on Concrete and Reinforced Concrete.

The next in order is the report of the Special Committee on Concrete and Reinforced Concrete. This paper is too long to read in detail. I shall ask some member of that Committee to state to the Society the general features of that report.

RICHARD L. HUMPHREY, M. AM. SOC. C. E.—Mr. President, the work of the Committee since its last report of January, 1909, is best expressed in the paragraphs of the report which I will read.*

J. P. SNOW, M. AM. SOC. C. E.—I move, Mr. President, that the report be received.

(Duly seconded.)

THE PRESIDENT.—It has been moved and seconded that the report just made be received and the Committee continued. As many as are in favor of the motion signify by saying "aye"; contrary, "no". It is so ordered.

Report of Committee on Engineering Education.

The next in order is the report of the Special Committee on Engineering Education.

DESMOND FITZGERALD, PAST-PRESIDENT, AM. SOC. C. E.—Mr. President, I have a report, signed and in proper form, which I carefully laid aside and came off and left behind me. It only shows what remarkable things a man can do; but, on the other hand, perhaps it is just as well, Mr. President, that that is the case, because almost all formal reports are more or less colorless. There is very little warmth

* See p. 117.

Report of Committee on Engineering Education (continued).

in them; and perhaps I can give a little more by stating briefly what the Committee has done.

At the last meeting, or the meeting before, I think I showed you some diagrams that we had made in regard to the studies pursued in the different colleges and technical schools of the country. After the Committee had dipped into that subject for about two years they made up their minds that it was a thing that we should have a large appropriation to continue properly; and the American Society of Civil Engineers at that time being rather poor, and with no available funds, we could not undertake the thing with a large force. We could only do what we could with individual efforts of the members of the Committee.

Now, I suppose there is no bigger subject to run up against than engineering education, and you know when you run up against a big subject it takes a lot of time, and you have to be very careful not to get caught by the enemy. It is just the same as with a fortress, the bigger the fortress the more you have to attack it from all sides and the longer it takes. The great thing, Mr. President, seems to be not to make any mistakes, and it was a rich field for pitfalls.

Now, the Carnegie Foundation, which is very liberally endowed through Mr. Carnegie's thoughtfulness, certainly is in a position where it can make this investigation and gather all the data, for twenty or forty thousand dollars, or whatever amount it may cost to do it, in good form and properly, and it has agreed to do it. It is simply a question of time. Since our last meeting, since I made my last report, Dr. Pritchett has been very ill for nearly a year, has been away in California, and nothing could be done. Now, I should like to say, for the information of those who do not know about our Committee on Engineering Education, and I say this because I have heard that some people think we have not done any work, but I think they are the people who have not done much work themselves in this direction, that we have done a good deal of work, and we have collected a good many data.

We have worked in connection with a large committee, a very large committee, and I should like to read the names of the committee, if we have a little time. Before beginning, I want to say that during the last year we have lost one of the most valuable members of our Committee by the death of Major B. M. Harrod, of New Orleans, and I need not say a single word in regard to that lamentable occurrence. I do not think the American Society of Civil Engineers ever had a warmer friend or a finer engineer than Mr. Harrod. Personally, I relied a good deal on his judgment and his great interest. On this subject of Engineering Education he wrote me long letters, and we had frequent correspondence about it, and there was no kinder or nobler man than Mr. Harrod.

With Mr. Harrod was Mr. Bates and Professor Mead and myself, representing the American Society of Civil Engineers; Messrs. Frederick W. Taylor, of Philadelphia, and Alexander C. Humphreys, of Stevens Institute, representing the American Society of Mechanical Engineers; from the Electrical Engineers, Mr. Charles F. Scott and Dr. Samuel Sheldon, of the Polytechnic Institute of Brooklyn; from the American Chemical Society, Mr. Clifford Richardson, of New York, and Professor H. P. Talbot, of the Massachusetts Institute of Technology; from the Mining Engineers, Dr. Henry M. Howe, of New York, and Dr. John Hays Hammond, also of New York. Then came Dean James M. White, of Urbana, Ill., Professor C. L. Crandall, of Ithaca, N. Y., Professor D. C. Jackson, of the Massachusetts Institute of Technology, and Dr. Henry S. Pritchett, of the Carnegie Foundation, and he was the last addition to the Committee.

Now, gentlemen, I do not know that the Committee itself can carry the work any further than it has done. I think that our usefulness, after having brought about the appropriation of the necessary funds by the Carnegie Institute to carry on this work—and it will probably take three or four years to finish it, and they are willing to spend a liberal sum of money—I think our work is practically ended. At the same time, it is very necessary, perhaps, and I for one shall continue to work in this direction, even if I am not a member of a committee. I do not know whether to recommend the continuance of the Committee, or that it be discharged, but I should think that it might be continued for a year to enable Professor Mead and Mr. Bates to aid in giving any advice as to the steps to be taken in the future. Thank you very much.*

THE PRESIDENT.—It seems to me that it is rather important that this Committee should be continued, to give direction to the work that Professor Pritchett proposes to do, and, if there are no objections, the report will be received and the Committee continued.

Report of Committee on Columns and Struts.

The next in order is the report of the Special Committee on Steel Columns and Struts, Austin L. Bowman, Chairman.

Mr. Bowman presented a Progress Report of the Special Committee on Steel Columns and Struts.†

THE PRESIDENT.—Gentlemen, you have heard the Progress Report of the Special Committee on Steel Columns and Struts, and the same action will be taken in this case. The report will be received and the Committee continued. The next in order is the report of the Special Committee on Bituminous Materials for Road Construction, W. W. Crosby, Chairman.

* The Progress Report of the Special Committee on Engineering Education, received subsequently, is printed on page 169.

† See p. 170

Report of Committee on Bituminous Materials for Road Construction.

Mr. A. H. Blanchard presented a Progress Report of the Special Committee on Bituminous Materials for Road Construction.*

THE PRESIDENT.—Gentlemen, if there are no objections, the Progress Report of the Special Committee on Bituminous Materials for Road Construction will be received and the Committee continued.

Report of Committee on Public Utilities.

The next in order is the Progress Report of the Special Committee on Public Utilities, Mr. Frederic P. Stearns, Chairman.

Mr. Stearns presented the following report:

PROGRESS REPORT OF SPECIAL COMMITTEE ON VALUATION OF PUBLIC UTILITIES.

TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS:

The Committee to Formulate Principles and Methods for the Valuation of Railroads and other Public Utilities is pleased to be able to report substantial progress.

Careful search has been made in the Library of the Society and bibliography prepared of articles and references to the subject under investigation.

The effort has been made to get in touch with the work of the various public service commissions and to obtain copies of their reports.

A good beginning has been made in the study of and report upon the principles underlying the art of valuing public utility properties.

Your Committee asks to be continued.

Respectfully submitted,

FREDERIC P. STEARNS, *Chairman,*
For the Committee.

JANUARY 14TH, 1913.

THE PRESIDENT.—The Progress Report of the Committee will be received and the Committee continued. The next in order are reports from the Board of Direction.

Special Committee on Employment and Compensation of Civil Engineers.

THE SECRETARY.—I have to report, Mr. President, that the Board of Direction has appointed a Special Committee to Investigate the Condition of Employment of, and Compensation of, Civil Engineers throughout the country, in accordance with the action of the Society, which referred the appointment of that Committee to the Board. The Committee is Alfred Noble, Chairman, S. L. F. Deyo, Dugald C. Jackson, William V. Judson, George W. Tillson, C. F. Loweth, and John A. Bensel.

Special Committee on Bearing Value of Soils.

I also have to report that the Board of Direction has decided to appoint a Special Committee of seven to Codify Present Practice on the Bearing Value of Soils for Foundations, etc., but as yet the Committee has not been completed.

* See p. 175.

To the Members of the American Society of Civil Engineers in Annual Meeting Assembled, January 15th, 1913:

Report of Board of Direction on Geographical Districts.

For a number of years the territory occupied by the membership of the Society has been divided into seven Geographical Districts, of which District No. 1 is the territory within 50 miles of the Post Office of the City of New York, and each of the other six, as nearly as practicable, contiguous territory, each containing, as nearly as practicable, an equal number of members.

It has always been a very difficult matter to arrange the Districts so that each of them should be in any sense local. In the Districts as now laid out, for instance, West Virginia, Arizona, and New Mexico, are in the same District; Kentucky and North Dakota are in the same District; Colorado and Washington are in the same District, and District No. 2 takes in the whole of the Dominion of Canada and the New England States, together with Europe and Africa.

As the membership increases it becomes occasionally necessary, under the Constitution, in order that the Districts shall be arranged "as nearly as practicable" with the same number of members in each, to make a re-districting, and during the past six months the Board has been endeavoring to do this. The result has not been particularly satisfactory, geographically, the only gain over the present division being a little more equal distribution in the number of members. For instance, in the best plan that has been worked out, Indiana, North Carolina, Florida, Texas, and New Mexico, are all in the same District. Illinois is in the District with Idaho and Montana, and New York State is in the same District with Minnesota. The second District is practically as it is at the present time, containing the whole of Canada, the New England States, and Europe.

It has been suggested that the representative character of the members of the Board of Direction could be better maintained if the territory outside of the Resident District was divided into twelve instead of six Districts as at present, making thirteen Districts in all. The number of Directors would in this case not be changed, and each of the twelve Districts would have at all times one Director, the number of representatives from District No. 1 remaining unchanged.

In the same way, instead of the appointment of two representatives from each of the Geographical Districts on the Nominating Committee, one representative would be elected from each (except from District No. 1), so that the Nominating Committee would be made up of two representatives of District No. 1, and one from each of the other twelve Districts.

With the present membership of the Society, there are about 1 400 Resident Members, and including foreign countries, the remainder of the membership is about 5 400. If this latter number were divided into twelve Districts there would be at the present time about 450

Report of Board of Direction on Geographical Districts (continued).

in each of the Districts. It is believed that a sub-division into twelve Districts can be worked out on State and Territorial lines, which would not only be more representative of certain sections of the country, but would also be much more permanent than is possible with only six Districts.

It is not possible to make this change except by an amendment to the Constitution, and the Board recommends to the Annual Meeting that the whole matter be taken up for discussion.

Under the Constitution, proposed amendments must be reduced to writing, signed by not less than five Corporate Members, and be presented to the Secretary not less than sixty days previous to the Annual Convention. Such amendments are then sent by letter to all Corporate Members of the Society at least twenty-five days previous to the Annual Convention, and are in order for discussion at the Business Meeting held during the Annual Convention. They may be amended in any manner pertinent to the original amendment by a majority vote of the Business Meeting, and if so amended shall be voted upon later by letter-ballot; if not so amended, they shall be voted upon by letter-ballot, as submitted.

If this course is taken in this matter, and an amendment to the Constitution covering this suggested change adopted, it will go into effect November 1st, 1913, in ample time for a change of the Districts before 1914.

The necessary changes to be made are very simple, and are as follows:

Amend Article VII—Nomination and Election of Officers—as follows:

Section 1, second line, strike out the word "seven", and substitute the word "thirteen".

Line 8, strike out the word "and" between 6 and 7, and add ", 8, 9, 10, 11, 12, and 13."

Strike out the first paragraph of Section 2, and substitute the following: "At the Annual Meeting of each year, seven Corporate Members, not officers of the Society, shall be appointed by the meeting to serve for two years. They shall be selected so as to provide, with the seven members holding over, two members from District No. 1, and one from each of the remaining twelve districts; and these with the five living last Past-Presidents of the Society, shall be a Committee to nominate officers for the Society."

Strike out the word "and" in the 15th line of the third paragraph of Section 2, and after the figure 7, add ", 8, 9, 10, 11, 12, and 13."

The whole article as it will read when so amended is attached to this report.

By order of the Board of Direction,

CHAS. WARREN HUNT,
Secretary.

JANUARY 7TH, 1913.

Discussion on Geographical Districts.

THE PRESIDENT.—Gentlemen, the recommendation of the Board in regard to districts is before you. What is your pleasure?

THE SECRETARY.—Mr. President, I might say that the intention of the Board, in bringing this matter before the Annual Meeting, was to get an expression of opinion, if possible, and to have some discussion of this suggested change, before it is placed before the Society in the form of an Amendment to the Constitution. In this way, the opinions expressed here will come before all the members in the *Proceedings*.

MR. G. W. TILLSON.—Mr. President, in order to get the matter before the meeting, I move that the recommendation of the Board be approved.

(Motion seconded.)

THE PRESIDENT.—Gentlemen, you have heard the motion moved and seconded. As many as are in favor of the motion signify it by saying "aye"; contrary, "no"; the recommendations of the Board are approved.

S. WHINERY, M. AM. SOC. C. E.—Mr. President, I understood that the object of this motion was to open this question to discussion by the meeting, and I think that that should be done. If necessary, therefore, I move that that motion be reconsidered.

(Motion duly seconded.)

MR. R. L. HUMPHREY.—What motion?

THE PRESIDENT.—I suppose we can go on with the discussion, if the gentlemen do not object to reconsidering it, without any further ceremony.

MR. R. L. HUMPHREY.—Do I understand that this meeting does not accept a recommendation of the Board to send out an amendment without being sent out sixty days in advance by letter-ballot? Why cannot this meeting order such an amendment to ballot, and have it sent out?

THE SECRETARY.—Such action would not be constitutional.

MR. R. L. HUMPHREY.—Mr. President, I submit that if this Annual Meeting should order this sent out unanimously, it would be perfectly legal.

THE PRESIDENT.—It cannot go out through letter-ballot until it has been presented to the Annual Meeting; as I understand it, the object of presenting it here is for the purpose of getting an expression of opinion from this meeting, and the expression that we give here will go out to all the members of the Society, so that they can act intelligently on the matter.

H. M. WILSON, M. AM. SOC. C. E.—Mr. President, I think I see the point that Mr. Humphrey intended to raise when he made his inquiry. I realize, as the Secretary states, that it would be unconstitutional to send this amendment out to letter-ballot at this time; but, for the purpose of getting a little discussion here, which it seems the Board would like to have, although it seems doubtful that you will get much, because I judge that, from their actions, most of the members here approve of

Discussion on Geographical Districts (continued).

this recommendation, I make this suggestion: The next action, as I understand, is the presentation in writing, by five members, of an amendment to the Constitution, and I make the inquiry as to whether or not, for the sake of debate here at this well attended meeting, five members might not get on their feet and say, "I will sign such a resolution as has just been presented." If that would meet the wishes of the Society and the President in the matter of opening the debate and starting the ball rolling, I may say it will give me great pleasure to sign such a resolution as has been offered.

MR. G. S. WILLIAMS.—Mr. President, I fully appreciate the sentiments of the Board of Direction in proposing these amendments, or this amendment; and, as far as it goes, it is all right, but it does not go far enough. Dividing six districts in two and making twelve instead of six, will not increase the number of members of the Board of Direction in attendance upon its meetings.

This Society has gotten so large now, we are reaching all over the world, and those who are on the outskirts, on the Pacific Coast, even in the Mississippi Valley, nevertheless feel somehow or other that they do not have enough to say about the running of it. I want to tell them—and I am one of that group, because I belong out in the central portion of the country—that they have as much to say about the running of it as they are willing to take upon themselves.

The reason the Pacific Slope does not run the American Society of Civil Engineers is because it does not get around here and do it; and the reason the Southern States do not run it is the same; and the reason that the Central States do not run it is the same; and the reason that the members here in New York and a few from New England and a few from Philadelphia do run it is because there is not anybody else around to do it, and the Society has to be run.

Now, I hear more or less sometimes from my friends in the outlying districts that this, that, and the other fellow is running the American Society of Civil Engineers. All I have to say to you who are complaining is, "get busy and run it yourselves". What we want here is not more representation or more diversified representation, but something that will get the fellows who are supposed to represent the business of this Society down here to do business, and I think that this Society is big enough and strong enough and wealthy enough to make it an object for each member of the Board of Direction to get here and do the business of the Society.

Now, while I am in favor of this amendment as far as it goes, I think that the Board of Direction or some specially constituted committee of this Society should carefully take into consideration a project to make our members on the Board of Direction from the outlying districts something more than mere figureheads.

THE PRESIDENT.—Gentlemen, I might give some word of my experience, and that is that at every Board meeting that I have attended here there have been members from Boston and from Roanoke and from Chicago, and various sections of the country, and there is no reason, as far as the authority of the Board is concerned, why the rest of the members of the Board should not have been present.

MR. N. P. LEWIS.—Mr. President, it seems to me that the thing we are most interested in is how these new men will affect the membership of the Nominating Committee. That Nominating Committee, I believe, consists of nineteen, four members elected from each district, and five past-presidents. Under the present system, every year there are eight of the nineteen new members elected to the Committee, not quite a majority. Under the new system there would be fourteen out of the nineteen new members elected every year, if I understand it.

THE SECRETARY.—I am afraid you do not understand it.

MR. N. P. LEWIS.—Twelve?

THE SECRETARY.—Six.

MR. N. P. LEWIS.—Twelve new members from each of the twelve new districts.

THE SECRETARY.—Six.

MR. N. P. LEWIS.—As I understand the report of the Board of Direction, it was that there be twelve districts outside of District No. 1, with one member elected from each of those districts each year.

THE SECRETARY.—One member from six of the districts to be elected every year.

MR. N. P. LEWIS.—Every two years?

THE SECRETARY.—One member from the six alternate districts to be elected the year thereafter.

MR. N. P. LEWIS.—Then the changes in the personnel would be the same as they are at present?

THE SECRETARY.—Yes, sir.

MR. N. P. LEWIS.—The only other thing I want to speak about is this: Mr. Williams, I think, intended—possibly I misunderstood him—to refer to members of the different districts not attending the meetings of the Nominating Committee or of the Board of Direction?

MR. G. S. WILLIAMS.—It applies to both. I was speaking of the Board of Direction more particularly.

MR. N. P. LEWIS.—It is true that it is an exceedingly difficult thing, and would likely be more difficult to have members of twelve outlying districts rounded up at the meeting of the Nominating Committee. This may not be germane to this particular amendment that has been proposed, but it might be possible, and it seems to me not unfair, to have the meeting of the Nominating Committee held in the different districts, provided—and I think this is only fair—provided that the expenses of the members of the Nominating Committee be paid for

Discussion on Geographical Districts (continued).

attendance of the members at that meeting. I believe there is a provision for that at the present time.

If you want to get local color, local atmosphere, let us have the meetings of the Nominating Committee held in different districts in successive years. It is proper that there should be some sort of continuity of purpose or quality in that committee. It is wise to have a certain number of holdovers unquestionably every year, and I cannot but believe that twelve districts, outside of the home district, would add interest to the meetings of the Committee, and if the meetings of the Committee could perhaps alternate every second year in the home district, and in other years in the various other districts in rotation, it would infuse a little more interest and life into the work of the Nominating Committee.

H. B. Seaman, M. Am. Soc. C. E.—Mr. President, in connection with the suggestion that the expenses of the Nominating Committee be paid for their attendance on the meetings, I believe that there is, or there has been, no provision by which their expenses are paid except by special action of the Board of Direction. I understand that for years past it has been found advisable to pay the expenses of directors who are willing to give their time to come to New York City to help manage the Society, but there has been no provision by which the Nominating Committee, which is the father of the Board of Direction, has its expenses paid. There are a number of men who went from the East to Seattle last summer, with no such provision. They paid their own expenses, and they gave their own time, and some of them had very little time to give. I know of one individual who went from Philadelphia to Seattle and spent half a day there to do his work, and came home. There is no provision in the Constitution to pay expenses, the actual expenses of such men.

There was a motion put in the Convention at Seattle that their expenses be paid, the same as those of the members of the Board are paid. I would like to ask, on behalf of the membership of the Society, what has been done by the Board in regard to that motion, if those expenses have been paid?

The Secretary.—Mr. President, the Board of Direction considered the resolution that was adopted at the Annual Convention in Seattle, and adopted a resolution to pay mileage to the members of the Nominating Committee at any one meeting that they should decide upon, whether it should be at the place of holding the Annual Convention or at some other point which would be more convenient for them; and that will be done in the future.

Mr. H. B. Seaman.—Was it done for those who went to Seattle?

The Secretary.—It was not, sir.

Mr. H. B. Seaman.—There you have the situation, gentlemen. We have a modification of the Constitution proposed by which if ten

men do not attend the meetings it would revert to the Board of Direction, which would practically make the Board of Direction a self-perpetuating body, because no men would ever be got together across country to attend that meeting. I do not think there is a record of any ten members of that committee attending the meeting. It could all be done by correspondence, but the provision of the Constitution is that they must attend. If they do not attend, it would revert to the Board of Direction, and they would become a self-perpetuating body, and it was understood by the Society that that would be attended to by the Board itself. I think the key to this situation is to nominate a Nominating Committee which can nominate and be ready to attend.

MR. R. L. HUMPHREY.—Mr. President, in District No. 4, we have Maryland and Washington and the District of Columbia, Delaware, Pennsylvania, and Ohio. Now, in the vicinity of Pennsylvania those who live in the southern end of Virginia and do their business in that particular section want to vote in that section, District No. 4. I think the districts should be fixed with some idea as to the centers of population in the districts selected. I think that District No. 4 should comprise the State of Pennsylvania and all of New Jersey which is not in the first District. I think this is a matter in which there should be action taken. It is manifestly impossible for the people in Ohio to be in touch with the people of Pennsylvania, in attempting to get a proper representation of the Nominating Committee, and it seems to me that the provision dividing the districts into twelve is a proper one, and it is a pity that the red tape of this Society prevents us from taking needed action on something which we think is necessary.

MR. J. P. SNOW.—Mr. President, the point made by the last speaker in attempting to fix upon a new redistricting should be taken into consideration, but our last amendment to the Constitution precluded the dividing up of a State. I agree with Mr. Humphrey that that ought to be borne in mind, because in making these districts the prominent cities are the points to be considered with their contiguous territories. Philadelphia and Pittsburgh are in the same State, and it is a big one, and in order to make a good distribution, we need to divide some of the States, make the districts other than on Territorial or State lines; but, as I understand the resolution read by the Secretary, it simply states that it is thought that such a division can be made. It does not preclude the dividing of a State.

I think that the last amendment to the Constitution should be somehow abrogated by amendment, so that a State can be divided.

There is no particular difficulty in doing it, because very frequently we find that in the central portion of a State, like New York or Pennsylvania, there are very few of our members resident, and a line

Discussion on Geographical Districts (continued).

could be drawn which would make much better work, much better distribution, than on State lines.

THE PRESIDENT.—I want to say one word. The report does not contemplate lines on which districts shall be drawn; that is left to the Board of Direction, and I think you can rely on them to make the distribution so as to have certain large centers in each of the districts.

That will be the aim, as I understand it.

A. N. TALBOT, M. AM. SOC. C. E.—Mr. President, the provision for increasing the number of districts for the Nominating Committee strikes me as being a good one, but the other provision that a director shall be selected from each of those districts may lead us to have some directors from these far-away districts, and in this way increase the difficulty of getting a general attendance at the meetings of the Board of Direction. It seems to me that this part of the proposal should be considered further before being put on as a change in the Constitution, unless in some way the number of meetings of the Board could be reduced from monthly meetings to say quarterly meetings, in which case greater efforts could be made than at present.

JAMES BURDEN, M. AM. SOC. C. E.—The membership of the Society is so great that it seems to me it might be well, not only to increase the number of districts, but to increase the number of men representing those districts. Would it not be well to increase the number of districts and leave its membership at two members as it is now?

MR. H. M. WILSON.—Mr. President, the suggestion of the last speaker, which I note meets with some favor, opens up, even further than do Mr. Williams' remarks, the immensity of this question and its importance to the Society. I agree with Mr. Williams; I should go farther in an endeavor to have the meetings of the Society well attended; and I have cast rather a longing eye on the growing annual surplus of $30 000. I feel hungry, for one thing, physically hungry, because I understand that a resolution which was referred to the Board last year, suggesting that an effort be made to entertain us with luncheon in this building, so that we could come here and discuss these matters conversationally has been turned down. (Applause.) I presume that applause is not caused by agreement with what I understood was the opinion of a member of the Board of Direction, that it would be undignified for us to eat our luncheon here in this manner without cost. Therefore, I should be glad for one, to use some of the surplus for other purposes than furnishing luncheon, provided the members of the Board of Direction will permit us to pay for the luncheon here next time. Would it not be to the interest of this Society to pay, not only the traveling expenses of the Board of Direction, when they attend the Annual Meetings, but to pay them salaries as in some cor-

porations? Is not the business of this Society large enough to warrant that?

In making that suggestion, Mr. President, I do not say that I wholly agree to the proposition myself at this time, but it occurred to me as a thought worthy of consideration, while we are here and are debating this subject, as to whether or not we should so increase the membership of the Board of Direction as to make it prohibitive that we pay them any compensation for attendance, and perhaps even prohibitive that we even go so far as to pay traveling expenses for them and for the members of the Nominating Committee.

MR. S. WHINERY.—Mr. President and gentlemen of the Society, I think that a more important and interesting question is whether this provision of the Constitution and the practice of the Society, dividing the country into geographical districts, might not be advantageously abandoned altogether. Aside from one or two small items of the language proposed, I doubt if in the actual practice of administering the affairs of this Society, this question of geographical location enters in any important way. It may be remarked that our Society is, if I am correctly informed, the only large engineering or technical society in this country in which this geographical distribution is maintained.

It has been found entirely practicable and satisfactory to the other societies to do without such a geographical division. It seems to me the question might be very profitably considered here, whether this Society might not do away entirely with that whole provision and all the consequences and difficulties and complications that attach to it.

If, however, it is maintained, it seems to me that, with regard to the outlying districts, it is not necessary, under the Constitution or in practice, so far as I understand it, that the person elected as a Director for that district shall be resident in the district. Am I right about that, Mr. President, that Directors elected must be resident in the district?

THE SECRETARY.—At the time of his nomination, the Constitution says he must be resident there, and if elected he continues to represent that district, although he may move away.

MR. S. WHINERY.—He may move away; he may become a nonresident of that district. Now, why would it not be practicable and satisfactory to adopt practically the same idea that they pursue in Parliament in England? District No. 7, which is scattered, could take in members here in New York to attend all the meetings without difficulty, and they could be made to represent the interests of that district, so far as such representation is of any consequence. I doubt very much if it is of any importance, and, as a matter of fact, I think the affairs of the Society would probably be administered just as advantageously and just as satisfactorily by a body of directors elected

Discussion on Geographical Districts (continued).

within reasonable distances of New York City, as under the present system; but I think the main question that should be considered is whether it would not be wise to dispense entirely with this system of geographical distribution.

E. W. STERN, M. AM. SOC. C. E.—Mr. President, I should like to say a word on this question in relation to the method we now have of appointing the Nominating Committee. Inasmuch as the Nominating Committee is probably the most important body which has to do with this organization, inasmuch as it nominates the Board of Direction, I do believe that the policy or the system of having the Nominating Committee elected by informal ballot, in the manner at the present time in use, is not one which would get probably the best results. I believe that, inasmuch as the members of the Board of Direction are elected by the Australian ballot system, that the Nominating Committee should likewise be elected by the Australian ballot system. I see no reason why it should be otherwise.

We nominate these men, give them tremendous powers, and they nominate a Board of Direction, which in turn is elected by the Australian ballot system, but on very few occasions has the recommendation of this Nominating Committee ever been changed in the final balloting. We could really logically have an informal ballot on the recommendation of the Nominating Committee rather than an informal ballot on the election of the members of this Nominating Committee, which is the custom in vogue to-day.

THE PRESIDENT.—The question before the meeting is the report of the Board of Direction in regard to the proposed amendment, and we are not discussing the methods of selecting the Nominating Committee, or things of that sort. The discussion has been rather rambling.

MR. E. W. STERN.—With all due deference to your opinion, Mr. President, it seems to me that it has a bearing on the whole situation, as involving the methods of election of the Board of Direction and the subdivision, and so on. However, I defer to your judgment.

MR. R. L. HUMPHREY.—In order to get a motion before the meeting, I should like to move, Mr. President, that it is the sense of this meeting that such a change as outlined by the report read by the Secretary is desirable, that the Board, in reporting back such an amendment to the Society, remove the restrictions as to State and Territorial lines.

THE PRESIDENT.—Gentlemen, you have heard the motion. All in favor signify by saying "aye"; contrary, "no". The ayes seem to have it; the ayes have it.

MR. G. W. TILLSON.—Mr. President, is the original motion before the meeting? It seems to me, from the discussion we have had, that there is no question at all about adopting the report of the Board in general. It seems to me that if we should adopt that and then carry some other motion, which would make certain suggestions, that would

be the better way to proceed, either that the proposed amendment be drawn up by the Board or by the committee, whichever is seen fit. It seems to me, first, that we need to act upon the recommendation of the Board as a thing by itself.

MR. R. L. HUMPHREY.—Mr. President, I think the motion offered by myself covered that. It approved the suggestion and reported back the amendment that the restrictions should be removed.

THE SECRETARY.—Mr. President, an amendment to the Constitution may be proposed by any five members of the Society. The object of the Board, in making this report to this Annual Meeting, was to have a discussion in order that the ideas of the members here could be gotten. Now, I think the Board does not need any further instructions about the matter, unless this meeting wants to pass a resolution that it does not approve of any part of this proposition. The suggestion that was made about the removal of the State and Territorial lines is certainly a very good one. That, as far as I have heard, is about the only suggestion that has been made for a change.

MR. S. WHINERY.—Mr. President, in order to get the trend of this meeting with reference to the question of geographical distribution, I move that it be the sense of this meeting that the provision for the geographical distribution of members and every other item of the Constitution which looks to geographical distribution be changed and abolished.

THE PRESIDENT.—It seems to me that we have already approved of the recommendation of the Board.

MR. S. WHINERY.—I intend to introduce this as an entirely new motion. I understood your decision to be that the other question was disposed of.

A MEMBER.—Is there a motion before the house?

THE PRESIDENT.—There is no motion.

A MEMBER.—I second the motion.

THE PRESIDENT.—Will you state that motion again?

MR. S. WHINERY.—That motion is that it be the sense of this meeting that all provisions in the Constitution relating to the division of the territory into geographical sections and to sectional representation and everything else relating to that matter be abolished.

THE PRESIDENT.—Gentlemen, are you ready for the question?

MR. G. S. WILLIAMS.—I believe that Mr. Humphrey's motion was seconded. Was it ruled out of order by the chair?

THE PRESIDENT.—No; it was passed, carried.

MR. G. W. TILLSON.—Mr. President, just for information, I would like to know what became of my motion?

THE PRESIDENT.—Your original motion was carried, but there was a request afterward that the subject be discussed, and I was very glad to have it discussed; and Mr. Humphrey's motion, as I under-

Discussion on Geographical Districts (continued).

stand it, is practically identical with yours. Now, this motion by Mr. Whinery is before the house. Are you ready for the question?

MR. A. N. TALBOT.—Mr. President, does the passage of the resolution carry with it the approval of this body applicable to the geographical distribution? If so, I hope it will not be carried. It is one of the best things connected with the government of the Society. It has carried weight with the members away from the City of New York more than anything connected with the Society. It has been stated here that other National Societies do not have it. My information is that they wish they had, and it has been more or less unsatisfactory because of their lack of such distribution. I think the motion should not be carried.

R. S. BUCK, M. AM. SOC. C. E.—Mr. President, I ask for information; do I understand it is open to the Board to name its own lines of division, on this resolution of Mr. Whinery, or does it mean to wipe out the whole provision?

MR. S. WHINERY.—My intention was to wipe out the whole system of geographical distribution in the control of the Society, and put it precisely on the same basis as the other National Engineering Societies in that respect.

THE PRESIDENT.—You have heard the motion, gentlemen. As many as are in favor of it signify by saying "aye"; contrary, "no". The noes seem to have it; the noes have it.

MR. G. W. TILLSON.—I move that the whole matter be referred back to the Board of Direction, with a request that it prepare what it considers a suitable amendment in view of the discussion we have had here to-day, in time to be acted upon by the next Convention.

(Motion duly seconded.)

MR. R. L. HUMPHREY.—Mr. President, I submit that that is already covered by the preceding motion. It instructs the Board to do that.

A MEMBER.—I would like to know where we are at.

A MEMBER.—We have heard that the first motion was passed relating to the recommendations of the Board; is it a fact, or is it not, that that motion was passed, or was it made as a motion and then disposed of, or was it made as a motion and passed?

THE PRESIDENT.—It was made as a motion, passed, and then discussed; and it was made as a motion again, and now it is being discussed again.

A MEMBER.—The motion of the gentleman here was not the same as the gentleman made, to adopt the recommendations of the Board.

MR. G. W. TILLSON.—Mr. President, my first motion was that the report of the recommendations of the Board be approved. That I understand was carried. Now my second motion is that the matter be referred back to the Board of Direction for it to draw up what

it considers a proper amendment to carry out the general recommendations after having heard the discussion here to-day. That I do not think has been covered by any other motion.

THE PRESIDENT.—It is the purpose of the Board in sending out this suggested amendment to accompany it with the remarks that have been made here to-day. Now, I will put this motion, in order to be sure to have all the motions on the same subject. As many as favor the motion just stated signify by saying "aye"; contrary, "no". The ayes have it.

MR. S. WHINERY.—This only postpones action in this matter, if it is to go back to the Board; if you must approach the Board through five members who petition for a certain amendment, the Board considers it and must present that to the next Annual Convention or the next Annual Meeting. It simply delays action, as I understand it, for six months.

THE SECRETARY.—Your statement, if you will pardon me, is not a correct one. When five members suggest an amendment the Board has nothing whatever to do with it. It must go to the Society in a certain way.

MR. S. WHINERY.—Still, Mr. Secretary, does not my contention stand true that to refer this again to the Board simply means a postponement of consideration of the question for six months more?

THE SECRETARY.—I do not think so, sir. Under the Constitution, no amendment can be voted upon and become operative until next October; that is the best that can be done.

THE PRESIDENT.—The next thing in order is a letter from E. W. Clarke, M. Am. Soc. C. E.

THE SECRETARY.—The letter is as follows:

Discussion on Presentation of Papers.

"PLEASANTVILLE, N. Y.,
"DECEMBER 31, 1912.

"Board of Direction,
"American Society of Civil Engineers.

"GENTLEMEN.—It has appeared to me from a rather infrequent attendance at the semi-monthly meetings of the Society that the practice of reading papers and the discussion thereon at these meetings is of really very little value and that at this time it might be proper to suggest that such readings be discontinued.

"Those who are interested in any particular paper read it and the discussions at a time when they can get the greatest benefit from it, and more than 75% of the membership are entirely dependent on this method of using the papers. The great listlessness which is generally shown during the reading of the papers and the reluctance of the members to enter into any verbal discussion seems to me to indicate that very little interest is taken in the actual presentation at the

Discussion on Presentation of Papers (continued).

Society meetings. This is emphasized by the great rarity with which papers are presented by their authors, and it must be a great burden to the Secretary to read papers which he evidently does not have opportunity to read over beforehand.

"Personally, I generally go to these meetings in hope of seeing friends, whom I would not meet otherwise, and it seems to me that if, for instance, some informal presentation could be arranged of actual construction work illustrated by lantern slides on some big or little job by men actually engaged on the work, or some similar short entertainment, and the bulk of the evening devoted to a social meeting, it would tend to get larger attendance than is now the case.

"I request that this letter be read at the Annual Meeting, and in order to get an expression of opinion from the members that the following be offered:

"That the President appoint a committee of five to investigate and report at the regular business meeting in March, 1913, on the possibility of securing suitable engineering entertainments to take the place of the reading of the formal papers for the semi-monthly meetings.

"Yours truly,

"E. W. CLARKE, M. AM. SOC. C. E."

A MEMBER.—I second the motion.

THE PRESIDENT.—You have heard the motion, gentlemen. Are you ready for the question?

E. W. CLARKE, M. AM. SOC. C. E.—I do not wish, Mr. President, to appear in the attitude of being a critic of the reading of the papers at the semi-monthly meetings. I think they are one of the most important features of the Society; but, as I said in the letter, the Society meetings do not seem to be productive of any great interest, and while that may not be the best method of making the members take an active interest in them, it seems to me possible that some scheme might be gotten up that would get more members here, and have them display greater interest in the semi-monthly meetings, and I wrote the letter in the hope that there would be a discussion, and that some action might be taken along those lines.

O. E. HOVEY, M. AM. SOC. C. E.—Mr. President, I would like very much to discuss this matter, and there are one or two things that it appears to me that I might say a word or two upon. It was my privilege to be located temporarily in the City of New York when we were located at 127 West 23d Street. I did not miss a meeting during the time I was in the city. You could not have kept me away from the meetings, unless I was sick, or something of paramount importance had occurred. They were attended generally. The papers were discussed and very well discussed, frequently with slight passages of humor,

which did not necessarily appear in the published *Proceedings* afterward. The papers were thoroughly appreciated, and discussed in a way that I and a great many of my friends enjoyed to a very great extent, and in attempting to attend the meetings recently I noticed that, while the Society has grown greater, the interest seemed to be less.

There is another point that I would like to refer to. A young man whom I have been acquainted with for several years, who is a very keen, brainy fellow, deeply interested in his work, and joined the Society with a great deal of enthusiasm, has actually resigned during the last year, because he came up here, and the meetings did not interest him, and he did not see anything to come for. He told me, not three days ago, that if anything on earth could be done to bring about interest in these meetings, he would apply for re-admittance immediately.

W. J. Boucher, Assoc. M. Am. Soc. C. E.—I agree with Mr. Clarke that the meetings are fairly attended, and there is a spirit of listlessness in the proceedings. Naturally, the experience and interest which the author would have if he were here to present it, is not present when he is not here. I have noticed lately that, for the most part, the authors, unfortunately, have been from beyond the Mississippi River, which makes it more or less difficult for them to attend; but the papers were of great value and great interest.

I am not in favor of abolishing the reading of the papers. What we want is more discussion, but, unfortunately, it would appear that the membership is afraid to discuss the papers or afraid to criticise them in any way.

In one paper, recently, the author asked that there be a free and liberal discussion of his subject, which was not very often treated in the engineering press. I told a little of what I had seen and heard, which was not much, but I was the only one of probably a hundred who rose to discuss the question. We want more discussion.

In a certain club in New York City, devoted to railroad interests particularly, I know that preparation is made in advance by calling upon well-known men who can discuss the subject, and members are asked to come prepared to discuss it. Now, our Society is big enough, and the membership in this neighborhood is large enough, that it seems to me that those qualified to speak, or those connected with that class of work, might be called upon to come prepared to add something to enhance the interest of the papers. We are not a social organization, but an engineering organization, for the dissemination of engineering knowledge.

T. C. Atwood, M. Am. Soc. C. E.—Mr. President, I wish to speak in favor of Mr. Clarke's motion. I have attended the meetings quite regularly here for the last five or six years, and it has been increasingly borne in upon me that we do not get out of the meetings

Discussion on Presentation of Papers (continued).

what we should. It is no uncommon thing for the paper on the programme to be read by title, at the suggestion of the Secretary, and for there to be practically no discussion, with the result that the meeting is all over in a few minutes.*

This gives plenty of time for social intercourse afterward, if there are sufficient members present to make it enjoyable, but, if the programme of the meeting amounts to so little, the attendance is likely to be slim also. It is true that many of the papers are long and difficult to present in an interesting manner, and that we are supposed to read the papers in the *Proceedings* and to prepare discussions beforehand, but there are a great many men who do not find time to read the papers beforehand, however good their intentions may be.

I have devoted some thought to this question, and it seems to me that we might pursue an intermediate course which should give more satisfactory results; that is, present an abstract of the paper so as to have something actually before the Society to discuss. As it is now, if the paper is not read, there is nothing directly before the meeting, and those who have not made preparation beforehand cannot be expected to discuss the paper, but if the paper is presented to them in a brief and interesting form, many could add some points from their experience which would be illuminating and make the meetings of greater interest.

The abstract of the paper should be prepared by its author, and every inducement should be made to have the authors read their own papers. If, for any reason, however, the author fails to send an abstract of his paper, such an abstract should be prepared by the Secretary and presented. Abstracts of long written discussions should also be prepared and read. Whenever possible, lantern slides should be prepared to add interest to the presentation of the paper, and the author should be allowed to have these slides prepared at the expense of the Society, the only requirement made of the author being that he furnish suitable photographs or drawings.

We all realize this morning that the acoustic properties of this hall are very poor. Hardly anything that has been said was audible over more than two-thirds of the hall. This makes it especially important that in meetings, where the interest is sure to flag when the speaker cannot be heard, the papers be read by some one who not only understands the subject and is familiar with the paper, having read it a sufficient number of times beforehand to present it to good effect, but is also endowed with a good voice and can make himself

* Mr. Atwood's attention was called to the fact that his original statement to the Annual Meeting was not in accord with the records, and an opportunity was given him to change it. While, however, he has made considerable modification in that statement, it is still in a form which, unless corrected, would give a false impression to members who have not attended meetings during the past five or six years. A statement of the facts as to the presentation of papers and discussions during that period has therefore been prepared for the information of the membership and will be found on page 103. (Secretary.)

heard all over the hall. The Society is in a prosperous condition, and we can easily afford to hire some good speaker, who is familiar with engineering work, to present the papers or their abstracts, together with the written discussions, so that every one present can hear and enjoy them.

I thoroughly believe that a more satisfactory presentation of the papers, both as to quantity and method of presentation, will make the meetings sufficiently interesting to insure a larger attendance and make both the programme and the social parts of the evening worthy of every man's attention.

F. R. HARRIS, M. AM. SOC. C. E.—Mr. President, I ask to have Mr. Clarke's motion read, please.

THE SECRETARY.—Mr. Clarke's motion was that the President appoint a committee of five to investigate and report at the regular business meeting in March, 1913, on the possibility of securing suitable engineering entertainments to take the place of the reading of the formal papers for the semi-monthly meetings.

MR. F. R. HARRIS.—Mr. President, I think that one of the most important functions of a technical society of this sort is the technical papers, the papers on engineering, the papers that are submitted, whether they are printed or read. There are probably two kinds of papers that you receive, one type of paper is one of general interest, one that reads well and one that brings a large attendance at the meetings. The other type of paper is probably more technical, more special, and dryer; but it is very often the case that the second type of paper is the more useful one to the members of the Profession, perhaps not at that particular time, but later, when they may want to refer to it and see what has been done on the subject. For instance, I noticed in the past year there was a paper on physical valuation. Now, I was not here when that paper was read, and it must have been extremely dry reading to most of those in attendance, but it was an extremely useful and interesting type of paper. I mention it because it occurred to me that if a committee—some auditing committee or some committee who would look over these papers—could divide the papers into two types, one paper for publication and the other paper that they thought would be of more interest and would bring a larger attendance to have it read.

Another thing is to arrange discussion by invitation in advance, and that suggests the securing of special papers by special invitation.

In connection with that there are some societies, technical societies, that offer inducements in the way of presentation of papers; that is, they pay for them, and one of the gentlemen here to-day said that the Society was so well off, and had so much of a surplus, that it might be a very good way to use some of that surplus. It would probably be impossible to pay enough to warrant a man of experience spending any great amount of time on it. I mean, you could not pay for his

Discussion on Presentation of Papers (continued).

time, but you could at least partly reimburse him for the expenses he would be put to in the preparation of the paper.

I had the experience not very long ago, in another Society, where I did not know they paid for papers. After my paper was published, I received a check for $40. It went quite a way toward paying the expense I had been put to, and was very welcome, and I think that would to some extent induce more of the members to go to the expense. I would therefore offer an amendment. Is this a resolution or a motion?

THE SECRETARY.—A motion.

MR. F. R. HARRIS.—I offer an amendment to it: Instead of the motion as it is written, that the entire subject be referred to a committee for careful investigation for recommendation and report. It seems to me that it is entirely too large and broad a question to be handled in this offhand manner; and I think the proposition—I may not be right, but it seems to suggest that we do away entirely with papers and have engineering entertainments. Engineering entertainments is a very broad term. I do not suppose that we are to have a cabaret show or anything of that sort here. It might change the entire character of this Society from a highly important professional society to an amusement society, and I do not believe any of us want that. So I would offer that as an amendment, that a committee be appointed by the President to investigate the entire subject and report and recommend what steps—by amendment to the resolution now before this Society—what steps should be taken in order to secure more interesting papers, and to take up the question also of what papers should be read, what papers should be merely published and not read, and also the question of some compensation for the publication of papers.

MR. G. S. WILLIAMS.—Mr. President, I am to some degree in harmony with the sentiments of the last speaker, but it does not seem to me that we need to increase the interest of our papers. I think our papers are good enough. It is rather the manner of the presentation that is at fault. I certainly object to anything like the reflection that the papers that are presented before this Society are not interesting. They are interesting, the most interesting engineering reading that you can find; and it is simply a matter of presentation. I would move an amendment to substitute that a committee of five be appointed to consider an improvement in the methods of the presentation of papers before this Society.

(Motion duly seconded.)

A MEMBER.—I move an amendment that the whole matter be referred to the Board of Direction.

MR. W. J. BOUCHER.—Mr. President, the Board of Direction probably has enough to do without this. A committee of five can handle it.

THE PRESIDENT.—Will you state that motion again, Mr. Williams?

MR. G. S. WILLIAMS.—That a committee of five be appointed to consider and report upon an improvement of the methods of the presentation of papers before this Society.

THE PRESIDENT.—That you move as a substitute motion?

MR. G. S. WILLIAMS.—I move that as a substitute for the original motion.

THE PRESIDENT.—Gentlemen, you have the motion. As many as are in favor of it signify by saying "aye"; contrary, "no". It is so ordered.

Letter Relating to Marketing of Engineering Services.

The next thing in order is a letter from Percival M. Churchill, Assoc. M. Am. Soc. C. E., asking that action be taken to appoint a committee to draw up a form for establishing an exchange for the marketing of engineering services of every sort.

THE SECRETARY.—Mr. Churchill's letter is as follows:

"ELMWOOD, MASS., JANUARY 7, 1913.

"The Secretary,
"American Society of Civil Engineers,
"220 West Fifty-seventh Street, New York City.

"DEAR SIR.—As I do not expect to be present, will you kindly present for me at the Annual Meeting the following:

"Moved: That the Board of Direction be instructed to confer with the officers of the Am. Institute of Consulting Engineers, the Am. Soc. of Mechanical Engineers, the Am. Institute of Electrical Engineers, and of any other Engineering Society it deems proper to include, for the purpose of ascertaining if these Societies will join with us in appointing a joint Committee to draw up a plan for the establishment and operation of an Exchange for the Marketing of Engineering Services of every sort. The Board of Direction to be authorized and instructed to appoint the Committee from this Society as soon as any of the other Societies signify their willingness to join in the work.

"This motion is now offered because the time has arrived when engineers as a body can no longer delay with dignity and in justice to the profession and to the public the performance of this important duty.

"What is here proposed will develop far beyond the scope of an employment bureau. It is the handling in a scientific and business-like manner the problem of the proper supervision of the engineering work of the country. It is applying "Scientific Management" to the expenditure of the wealth of the public by selecting competent men to direct that expenditure.

"Our present lack of system is extremely wasteful of the engineering talent of the country, which costs so much to train, and wasteful of vast amounts of public wealth thro its expenditure being placed in incompetent hands. For example, outside of the cities and the State work the greater part of the money spent in this country on highways is wasted thro incompetent handling, while at the same time hundreds of engineers who could save most of this waste are idle, because there is no work for them. Cities and towns are wasting large

Letter Relating to Marketing of Engineering Services (continued).

amounts in construction, and later in avoidable repairs on waterworks, sewers, lighting plants, etc., because they do not know how to select proper engineering supervision, or do not even realize that engineering supervision is necessary. Enormous wealth has been wasted thro needless litigation over water rights in the West, which could have been almost entirely avoided had the engineers of this country taken prompt, persistent, combined action to bring about a proper settlement thro the education of the public. And engineers as a body are responsible if this waste is allowed to continue, for they have the knowledge to work out and the power to put in operation the remedy.

"The proposed motion involves one of the most important steps in applying the needed remedy. Not only should this bureau properly distribute the available engineering talent to the available work, but it should conduct an active progressive campaign of education among State, City and Town officials, among business firms and among the public, to demonstrate what they would gain by placing their work in the hands of competent engineers. It would teach these parties that it would provide the proper talent for any kind of engineering work, and also what is a fair and proper compensation for this service. It should and could raise the public estimate of the engineer to a point where the public engineering work would be trusted to him rather than to lawyers, merchants, and barbers, as is the case at present. It would undoubtedly to a considerable extent check the present threatened absorption of the cream of the engineering work by a few large engineering corporations.

"The Committee of this Society which was appointed to investigate engineering conditions will furnish valuable data with which to work out the details of this plan. The need for its establishment is here, and this motion is the first step toward its accomplishment. Let us take it now.

"Respectfully,

"PERCIVAL M. CHURCHILL."

A MEMBER.—I move that the matter be referred to the Board of Direction.

(Motion duly seconded.)

THE PRESIDENT.—You have heard the motion, gentlemen. As many as favor that signify by saying "aye"; contrary, "no". It is so ordered.

Letter Relating to Proposed Code of Ethics.

THE SECRETARY.—I have still another letter from Mr. Churchill dated a day later.

"ELMWOOD, MASS., JANUARY 8, 1913.

"The Secretary,
"American Society of Civil Engineers,
"220 West Fifty-seventh Street, New York City.

"DEAR SIR.—Several of the large engineering societies have recently adopted Codes of Ethics. The Am. Soc. of M. E. has a Code under consideration now which is the result of a study of those of the other Societies and which was drawn up with the idea of its being applicable to engineers generally. Two out of the five members of the Committee which had this matter in charge are also Members of this Society.

"Under these circumstances it would seem proper to consider the adoption of this Code as it stands without the formality of submitting it to a Committee of this Society. I therefore wish to make the following motion:

"*Moved:* That this Society shall consider the adoption of the Code of Ethics for Engineers recently proposed by a Committee of the American Society of Mechanical Engineers and published in *Engineering News,* January 2, 1913.

"That the proposed Code be printed as a letter ballot and submitted to the members of this Society with the request that each member vote to accept or reject the Code article by article; that where a member so desires he shall—after voting against a certain article—submit a substitute in the form he desires that article to take. In the same manner additions may be presented.

"This ballot to be closed on April 1st, 1913.

"The Board of Direction shall then send out a second letter ballot giving the Code as first proposed and also any suggested changes and additions. Members shall again vote article by article. The ballots to be opened at the next Annual Convention and any article having a majority of the votes cast shall be declared adopted.

"The Code as thus adopted to be then printed in the *Proceedings* and the *Transactions* of the Society.

"Respectfully submitted,

"PERCIVAL M. CHURCHILL, ASSOC. MEMBER."

THE PRESIDENT.—What is your pleasure?

MR. G. S. WILLIAMS.—I move that the motion be referred to the Board of Direction.

(Motion duly seconded.)

THE PRESIDENT.—Gentlemen, you have heard the motion. All in favor of it signify by saying "aye"; contrary, "no". It is so ordered.

The next thing in order is the matter of the International Engineering Congress.

Proposed International Engineering Congress.

INTERNATIONAL ENGINEERING CONGRESS—1915.

For the information of the membership of the Society, the Secretary begs leave to report as follows:

That early in 1912 engineers belonging to this and other National organizations resident on the Pacific Coast, suggested the holding of a National Engineering Congress in San Francisco in 1915, during, and in connection with, the Panama-Pacific Exposition. A plan for the organization of this Congress which provided that each of the Societies should separately undertake the work of the Congress in its special line of engineering was presented, and this Society was asked to undertake the carrying out of that part of the Congress relating to Civil Engineering.

At the request of the Board of Direction, the Secretary visited San Francisco in February and March, 1912, and conferred with mem-

Proposed International Engineering Congress (continued).

bers of this Society, and of the other Societies there, with the result that the plan of organization was entirely changed to the following:

The whole scheme was to be underwritten as follows:

To the amount of $10 000 at least, by subscription on the Pacific Coast, and each of the five National Societies to underwrite the scheme for the following amounts: American Society of Civil Engineers, $9 000; American Institute of Electrical Engineers, $9 000; American Society of Mechanical Engineers, $5 000; American Institute of Mining Engineers, $5 000; and the Society of Naval Architects and Marine Engineers, $2 000.

This would make up a total Guarantee Fund of $40 000, which it was believed would be more than ample to defray any extra expenses.

All of the Societies above mentioned have, at the present time, agreed to underwrite the amount specified, except the American Institute of Electrical Engineers. That Society, having already agreed to conduct an Electrical Congress, did not feel that it could do quite so much for the project, but readily agreed to furnish $3 500.

The $10 000 from the Pacific Coast has already been subscribed, and we are informed that this Fund can probably be increased without difficulty to $5 000 more, so that there is no question that the financial backing of the proposed Congress is assured.

The general idea of the Congress is that its organization and entire management shall be in the hands of a General Committee, in which each of the five Societies undertaking the Congress shall have an equal representation, namely, six members each (except the American Institute of Electrical Engineers, which will have four), making a total Committee of twenty-eight members; that two of the members representing each Society shall be, *ex-officio*, its President and Secretary, and that the other four members shall be selected from the active membership of each Society resident in or near San Francisco.

The resulting publications are to be issued as a whole, and forwarded to each engineer who becomes a member of the Congress; and all American, as well as Foreign Engineers, are to be invited to join the Congress upon payment of a small sum sufficient to cover the cost of the issue to them of all of the papers and discussions received.

It appears at the present time that the holding of this Congress is assured.

THE PRESIDENT.—Any new business?

Lunch at Annual Meeting.

MR. H. M. WILSON.—Mr. President, I have a matter of old business that I would like to bring up at this festive hour of noon, and I do it with some hesitancy. I was asked by several men, immediately upon my entrance to the building this morning, as to what action had been taken by the Board in the matter of our arranging to lunch somewhere; and I ask as a matter of information, because I have not

heard of any action of the Board. What action was taken in connection with the recommendation last year that the Board consider the matter of arranging for luncheon?

THE SECRETARY.—Mr. President, the resolution adopted at the last meeting was considered by the Board of Direction, and the Board decided—I have not the Board's minutes here, unfortunately, or I would give the exact wording—that it was not advisable to undertake the serving of a lunch here in this building at the time of this meeting.

MR. H. M. WILSON.—Was the reason assigned the inadequacy of the accommodations here?

THE SECRETARY.—That is what it is.

MR. H. M. WILSON.—Mr. President, I move that the Board of Direction be, and hereby is, authorized to consider plans for increasing the capacity of the Society House, so that it may accommodate the members at annual and other meetings.

THE PRESIDENT.—Is there a seconder to that motion?

MR. T. C. ATWOOD.—I second the motion. It stands now ready for discussion. I move to amend that motion, Mr. President, by requesting the Board of Direction to secure suitable accommodations for the Annual Meeting, either by increasing the accommodations in this building or securing suitable temporary accommodations elsewhere. It does not seem that it will be absolutely necessary perhaps to increase this building at large cost, simply for one meeting in the year.

THE PRESIDENT.—Mr. Wilson, will you please state your motion?

MR. H. M. WILSON.—That the Board of Direction be, and is hereby, authorized to consider plans—that does not necessarily mean building plans—for increasing the capacity of the Society House to better accommodate the membership at Annual Meetings and other meetings; and I think such an amendment, or any other plan that would meet this purpose, which would better accommodate the members at the Annual Meetings would be wise.

THE PRESIDENT.—There does not seem to be any objection to having the Board of Direction consider that matter. As many as favor that motion signify by saying "aye"; contrary, "no". The ayes seem to have it; the ayes have it.

Acoustics of Auditorium.

H. H. QUIMBY, M. AM. SOC. C. E.—Mr. President, I would like to bring up an old matter, which has never been satisfactorily disposed of. I think it is a reproach to a Society so scientific as ours is, and which has such a surplus of revenue as ours seems to have, that it continue to maintain an auditorium with such uncommonly poor acoustic properties as this room has.

I remember the very first meeting we had in this room; it was not as large as this. It was very soon perceived that members were changing their seats to hear what was being said by the different members, and attention was called to the matter, and somebody asked whether

Acoustics of Auditorium (continued).

something could not be done to improve these acoustic defects. Some member suggested that wire might be hung across the room, and some man misunderstood the meaning of the suggestion and approved it on the theory that it was a motion to hang the architect.

To-day I noticed that a speaker in the rear of the room was speaking while the President was, and apparently neither realized that the other was speaking. Clearly, Mr. Clarke did not realize that the President was speaking at the same time.

Now, I move that the Board of Direction be requested by this meeting to employ the best talent that is available and do something to make it more satisfactory to the hearers in this room and to the speakers also.

(Motion duly seconded.)

THE PRESIDENT.—Gentlemen, you have heard the motion that the Board of Direction be authorized to employ an expert to consider the matter of improving the acoustics of this hall. As many as are in favor of that signify by saying "aye"; contrary, "no". It is carried.

Ballot for Officers.

The next in order is the announcement of the result of the ballot, the report of the tellers to canvass ballots for officers.

THE SECRETARY.—The tellers report as follows:

For President:

GEORGE F. SWAIN	1 724
Scattering	11

For Vice-Presidents:

J. WALDO SMITH	1 713
CHARLES H. RUST	1 716
Scattering	12

For Treasurer:

JOHN F. WALLACE	1 724
Scattering	9

For Directors:

District No. 1.	HENRY W. HODGE	1 674
	JAMES H. EDWARDS	1 666
	Scattering	7
District No. 2.	LEONARD METCALF	1 669
	Scattering	8
District No. 4.	HENRY R. LEONARD	1 662
	Scattering	10
District No. 5.	EDWARD H. CONNOR	1 668
	Scattering	9
District No. 7.	SAMUEL H. HEDGES	1 668
	Scattering	8

Officers Elected.

THE PRESIDENT.—The report read by your Secretary shows that by your ballot you have elected George F. Swain as President, J. Waldo Smith and Charles H. Rust as Vice-Presidents, and John F. Wallace as Treasurer.

Directors for District No. 1, Henry W. Hodge and James H. Edwards.

District No. 2, Leonard Metcalf.

District No. 4, Henry R. Leonard.

District No. 5, Edward H. Connor.

District No. 7, Samuel H. Hedges.

I would ask Mr. Stearns and Mr. Noble to escort the President-elect to the platform.

Remarks by President Swain.

PRESIDENT GEORGE F. SWAIN.—Fellow members of the American Society of Civil Engineers: I have no words to express adequately my appreciation of the great honor which you have done me in electing me to this office. I esteem it as the greatest honor that could come to an engineer in this country. As I recall the long roll of distinguished men who have occupied the position in the past, and as I look about me and see how many more there are equally distinguished, who are eminently worthy of it, I am at a loss to understand really how it has happened, and it is beyond my powers of analysis to figure it out.

Of one thing, however, I feel very sure, and that is that there is no member of this Society who has a higher ideal than I of the work of the engineer or of its value and consequence. I believe that the engineer, more than any other man, is the real civilizer of the world. It has always seemed to me that advances in civilization depended upon progress in material ways rather than upon advances in moral ideas.

The moral principles which should guide a man in the world were formulated certainly nineteen centuries ago, and may be found expressed in the writings of the old moralists in as complete a form as in any modern treatise; but in those days, of course, those principles were accepted and adhered to by few; and cities were arrayed against cities in warfare, tribe against tribe, and clan against clan; but the man who perfects a new system of transportation, or a new motive power, or a new means of abridging space and time, the man who harnesses the waterfall or the power of the sun's heat, which has been stored in the past, and makes those forces available in the manufacture of articles which conduce to the comfort of mankind, and which are needed in the distant countries to which they can be easily transported, or the man who by improving sanitary conditions conserves the life of the community—such a man, it seems to me, is doing a work which is really making the whole world akin, and conducing to a broader sympathy and the universal brotherhood of man; and therefore laying the foundations for advance in civilization and for true moral progress.

President's Remarks (continued).

Holding this in view, you can perhaps understand how deeply I esteem the honor of being President of what I hold to be the chief engineering society of this country, certainly the oldest.

I also thank you gentlemen because this act of yours is probably largely, if not mostly, due to a recognition of a branch of the Profession which has not hitherto been recognized in this way at your hands—a branch to which a large part, although not the largest part, of my life has been devoted, and that is the Profession of the engineering teacher. If we believe in the high mission of the engineer, we must necessarily believe that he must have the highest and best training which is possible—not that such training and education are always most evident in the schools—far be it from us to maintain that attitude. We have too many shining examples to the contrary to hold it; but, however or wherever such education is obtained, we must, as a Society, hold that the engineer should endeavor to get the highest and best that there is.

I thank you, therefore, for your recognition of this fact. In assuming office, gentlemen, I do so, not only with a high sense of the honor which you have conferred upon me, but also with a high sense of the responsibilities. Promises are easily made and easily broken, and all I can say is that as far as in me lies, and to the best of my ability, I will aim to promote the highest ideal of the Profession and to maintain the high standard which this Society has always maintained. I thank you, gentlemen.

The only duty which remains for me to perform at this time, I am informed, is to state that there will be a meeting of the Board of Direction, downstairs in the Secretary's office, immediately upon the adjournment of this meeting.

A MEMBER.—I move to adjourn.

(Motion duly seconded.)

Adjourned.

THE PRESIDENT.—It is moved and seconded that we adjourn. All in favor say "aye"; contrary, "no". It is a vote.

Data Relating to the Presentation of Papers and Discussions at Ordinary Meetings of the Society for the Six Years, 1907 to 1912, Inclusive.*

During 1907: 12 Papers were presented by Author (or his substitute),
8 " were read by Secretary,

20 Papers, none of which was presented "by title,"
40 Written discussions were read by Secretary,
10 " " " not read, first on account of lack of time; second, too mathematical to read,
60 Members discussed orally.

There was no meeting during 1907 at which a paper was not read—and no meeting at which either oral or written discussion was not presented.

During 1908: 11 Papers were presented by Author,
6 " " read by Secretary,
1 Topical Discussion opened by a Member,
1 Address by a Member,

19 Papers, none of which was presented "by title,"
15 Written discussions read by Secretary,
7 " " presented "by title," on account of lack of time,
74 Oral discussions.

There was no meeting during 1908 at which a paper was not read—and no meeting at which either oral or written discussion was not presented.

During 1909: 18 Papers presented by Author (or his substitute),
7 " read by Secretary,
4 " presented "by title,"

29 Papers, only 4 of which were presented "by title,"
36 Written discussions read by Secretary,
69 Oral discussions.

There was no meeting during 1909 at which a paper was not read—and no meeting at which either oral or written discussion was not presented.

During 1910: 15 Papers presented by Author (or his substitute),
8 " read by Secretary,
5 " presented "by title,"

28 Papers, only 5 of which were presented "by title,"
23 Written discussions read by Secretary,
16 " " presented "by title," all on account of lack of time.
54 Oral discussions.

There was no meeting during 1910 at which a paper was not read—and no meeting at which either oral or written discussion was not presented.

During 1911: 9 Papers were presented by Author (or his substitute),
12 " read by Secretary,
4 " presented "by title,"

25 Papers, only 4 of which were presented "by title,"
55 Written discussions read by Secretary,
5 " " presented "by title," all on account of lack of time,
57 Oral discussions.

There was no meeting during 1911 at which a paper was not read—and no meeting at which either oral or written discussion was not presented.

During 1912: 9 Papers presented by Author,
9 " read by Secretary,
7 " presented "by title" only,

25 Papers, 7 of which were presented "by title,"
40 Written discussions read by Secretary,
2 " " presented "by title," on account of lack of time,
82 Oral discussions.

During 1912 there were two meetings at which papers were not read, but there was good reason for this. At one of these the paper was a very long one, and there was some written discussion and considerable oral discussion. At the other meeting, there were two papers, one of which contained a great deal of tabular matter, and there were four written discussions read by the Secretary, as well as a great deal of oral discussion.

It will be seen from the above that during the six years covered by this statement, 146 papers were presented; 74 of these were presented by the author or by his representative; 50 were read in whole or in part by the Secretary, one introduced a topical discussion and one was a special address by a member. There were only 20 papers presented "by title."

Lantern slides were used to illustrate 53 of the 146 papers mentioned above.

During the six years there were only two meetings at which papers were not read, and the reason for this is clearly shown above.

* See reference on page 92.

EXCURSIONS AND ENTERTAINMENTS AT THE SIXTIETH ANNUAL MEETING.

Wednesday, January 15th, 1913.—In the afternoon, through the kindness of George W. Kittredge, M. Am. Soc. C. E., Chief Engineer of the New York Central and Hudson River Railroad, and G. A. Harwood, Chief Engineer of the Electric Zone Improvements, a large party was enabled to inspect the Grand Central Terminal Improvements. About 300 members and guests assembled at 2.30 P. M. at the temporary concourse of the Grand Central Palace, where they were met by representatives of the Engineering Department, under whose guidance many small parties inspected the Suburban Level, the Trucking Subways, Pipe Galleries, Service Plant for Light and Heat, Shops, Station Building, and many of the minor details of this extensive improvement.

At 9 P. M. there was a Reception, with dancing, in the Society House, at which there were present 400 members and about 300 ladies and other guests. Supper was served during the evening.

Thursday, January 16th, 1913.—By invitation of the Contractor, H. S. Kerbaugh, Inc., the members of the Society and their guests made an excursion to the Kensico Dam, one of the important features of the new Catskill water supply for New York City. The party (of about 600) was conveyed to Valhalla, near the site of the dam, in a special train which left the Grand Central Station at 10.15 A. M.

The dam crosses the valley of the Bronx River, about three miles north of White Plains, and will form a storage and distributing reservoir for the water impounded in the Catskills. The total capacity of the reservoir will be about 38 billion gallons, equivalent to a continuous supply for New York City for about 50 days at 600 million gallons daily. The maximum depth of water behind the dam will be 155 ft., and at the normal flow line elevation, 355 ft. above mean sea level, the reservoir will cover 2 218 acres. The total area acquired by the city—4 500 acres—provides a marginal protective strip averaging 500 ft. wide around the entire flow line.

The Kensico Dam will be a gravity structure of cyclopean masonry, 1 843 ft. long, with a maximum height of about 300 ft. It will be more than 170 ft. high for 1 000 ft. of its length. Its top width under the coping will be 28 ft., and the width of the base of the maximum section will be more than 250 ft. It will contain about 1 000 000 cu. yd. of masonry. The up-stream face will be of concrete blocks, and the down-stream face of granite. The entire dam will be divided into sections by transverse expansion joints about 79 ft. apart longitudinally.

After inspecting the excavation for the dam (about 80% completed) and part of the Contractor's plant, the party was entertained at

luncheon as the guests of the Contractor. After luncheon a visit was made to the quarry and the stone-crushing plant.

The party left Valhalla on the special train at 4.30 P. M. and arrived at the Grand Central Station at 5.30 P. M.

In the evening, at the Society House, there was an informal "Smoker" at which 800 members and guests were present.

The following list contains the names of 815 members who registered during the Annual Meeting. The list is not complete, however, as many members failed to register, and it does not contain the names of any of the guests of the Society or of individual members. It is estimated that there was an attendance of 400 ladies and other guests, making the total attendance at the Annual Meeting more than 1 200.

Abbott, C. P...White Plains, N. Y.
Adams, E. G., Jr...Waverly, N. Y.
Affelder, L. J.....Pittsburgh, Pa.
Aiken, W. A.....Philadelphia, Pa.
Aims, W. I.....New York City
Akerly, H. E.....Rochester, N. Y.
Alexander, H. J.,
White Plains, N. Y.
Allaire, D. A.....Brooklyn, N. Y.
Allen, C. Frank.....Boston, Mass.
Allen, C. M.....Worcester, Mass.
Allen, C. R., Jr.,
Saratoga Springs, N. Y.
Allen, E. Y..South Orange, N. J.
Allen, Kenneth...New York City
Allen, Walter Hinds,
Brooklyn, N. Y.
Ammann, O. H..Philadelphia, Pa.
Appleton, T. A.....Beverly, Mass.
Archer, A. R....Philadelphia, Pa.
Armstrong, G. S., Jr.,
Whitinsville, Mass.
Armstrong, R. W..New York City
Arnold, W. H.....New York City
Ashbaugh, L. E....New York City
Atwood, T. C.....Yonkers, N. Y.
Auryansen, F.....Jamaica, N. Y.

Babcock, W. S.....New York City
Baird, H. C.....New York City
Baker, Ira O.....Urbana, Ill.
Baldwin, F. H.....Bayonne, N. J.
Baldwin, T. A.....Boston, Mass.
Baldwin, W. J....Brooklyn, N. Y.
Bamford, W. B.....Belmar, N. J.
Banks, C. W..Pleasantville, N. Y.
Barker, C. W. T..Philadelphia, Pa.
Barker, J. M.....Boston, Mass.
Barnes, M. G.....Albany, N. Y.
Barnes, W. T.....Chicago, Ill.
Barnett, R. P.....New York City
Barney, P. C.....Brooklyn, N. Y.
Barney, W. J.....New York City
Barrett, R. E.....Boston, Mass.
Bascome, W. R....New York City
Basinger, J. G.Forest Hills, N. Y.
Bates, Onward.....Chicago, Ill.
Bayley, C. A. D...Montclair, N. J.
Beach, W. N.....New York City
Beaty, R. E.....New York City
Becker, E. J...Schenectady, N. Y.
Becker, R. C.....New York City
Beebe, J. C.....Butte, Mont.
Beekman, J. V., Jr..Boston, Mass.
Bellows, O. F....Rochester, N. Y.
Bellows, S. R.....New York City
Belzner, Theodore..New York City
Bennett, W. B....Harrisburg, Pa.
Bensel, J. A.....Albany, N. Y.
Bentley, J. C...Watervliet, N. Y.
Berger, Bernt.....New York City
Berger, John.....New York City
Beswick, J. E.,
Tompkinsville, N. Y.

Bettes, C. R.,
Far Rockaway, N. Y.
Bevan, L. J.....New York City
Blair, C. M....New Haven, Conn.
Blakeley, G. H.,
South Bethlehem, Pa.
Blakeslee, C...New Haven, Conn.
Blakeslee, H. L.,
New Haven, Conn.
Blanchard, A. H...New York City
Blatt, Max.....New York City
Boardman, H. S.....Orono, Me.
Bogert, C. L.....New York City
Boller, A. P., Jr.,
East Orange, N. J.
Booth, G. W.....New York City
Boright, W. P....Chatham, N. Y.
Boucher, W. J....New York City
Boughton, W. H.,
Poughkeepsie, N. Y.
Bowers, George.....Lowell, Mass.
Bowman, A. L....New York City
Bowman, D. W..Phœnixville, Pa.
Boyd, R. W.....New York City
Brace, J. H.,
Shelburne Falls, Mass.
Brackett, Dexter....Boston, Mass.
Bradley, F. E.....New York City
Brainard, A. S.,
East Hartford, Conn.
Brainard, Owen....New York City
Bramwell, G. W...New York City
Breitzke, C. F.....New York City
Breuchaud, Jules...New York City
Breuchaud, J. R...New York City
Brewer, Bertram..Waltham, Mass.
Briggs, W. C.....Brooklyn, N. Y.
Brink, L. C.....New York City
Brodie, O. L.,
West New Brighton, N. Y.
Brooks, Frederick...Boston, Mass.
Brooks, J. P.....Potsdam, N. Y.
Brown, B. S.....Boston, Mass.
Brown, D. H.....Alpine, N. J.
Brown, R. H.....New York City
Brown, S. P.,
Montreal, Que., Canada
Brown, T. E.....New York City
Bruning, H. D....Columbus, Ohio
Brush, W. W.....Brooklyn, N. Y.
Bryson, Andrew..New Castle, Del.
Buck, H. R.....Hartford, Conn.
Buck, R. S...San Francisco, Cal.
Buettner, O. G. H..New York City
Burden, James.....Oswego, N. Y.
Burdett, F. A.....New York City
Burgess, G. H.....Albany, N. Y.
Burpee, G. W.....New York City
Burpee, Moses.....Houlton, Me.
Burr, W. H.....New York City
Burroughs, H. R...New York City
Bush, E. W.....Lyme, Conn.
Bush, Lincoln..East Orange, N. J.

Cadwallader, W. L.,
New Rochelle, N. Y.
Cain, William..Chapel Hill, N. C.
Cantwell, H. H....Yonkers, N. Y.
Carey, E. G.....New York City
Carle, N. A.....Newark, N. J.
Carpenter, C. E...Yonkers, N. Y.
Carr, Albert..East Orange, N. J.
Carter, C. E.....Reading, Mass.
Casani, A. A.....New York City
Chadbourn, W. H.,
Brookline, Mass.
Chandler, E. L.,
New London, Conn.
Chappell, T. F.....New York City
Chase, C. F...New Britain, Conn.
Chase, W. H..New Bedford, Mass.
Christian, G. L...New York City
Christie, W. W....Paterson, N. J.
Church, E. C.....New York City
Churchill, J. P.,
East Orange, N. J.
Clapp, F. L.....Cornwall, N. Y.
Clapp, S. K..West Shokan, N. Y.
Clark, A. E.....New York City
Clarke, G. C.....New York City

Class, C. F.....New York City
Clermont, J. B....New York City
Coe, Robert.....Pittsburgh, Pa.
Coffin, T. DeL....Katonah, N. Y.
Cohen, F. W.,
Upper Montclair, N. J.
Cole, E. S.....New York City
Cole, G. N.....New York City
Cole, H. J.....Montclair, N. J.
Collier, B. C..Pleasantville, N. Y.
Coltman, Robert, Jr.,
Yonkers, N. Y.
Comber, S. X.....New York City
Connell, H. L.....New York City
Connor, E. H..Leavenworth, Kans.
Constant, F. H.,
Minneapolis, Minn.
Cook, J. H.....Paterson, N. J.
Coombs, A. W.....New York City
Coombs, S. E.....Yonkers, N. Y.
Cooper, D. R.....New York City
Cornell, J. N. H...New York City
Coyne, H. L.....New York City
Crandall, C. L.....Ithaca, N. Y.
Crane, A. S.....New York City
Crane, F. E....Amsterdam, N. Y.
Crehore, W. W....New York City
Creuzbaur, R. W...New York City
Crooks, C. H.....New York City
Crosby, Hewitt.....New York City
Crosby, W. W.....Baltimore, Md.
Crowell, Foster....New York City
Cummin, Hart.....Dayton, Ohio
Cummings, Noah..New York City
Cummings, R. A...Pittsburgh, Pa.
Currier, C. G.....New York City
Curtis, V. P.....Worcester, Mass.

Dahl, S. T.....New York City
Dakin, A. H., Jr...New York City
Davies, J. P.....New York City
Davis, A. P....Washington, D. C.
Davis, C. E.....Philadelphia, Pa.
Davis, J. L....Mt. Vernon, N. Y.
Dean, A. W.....Boston, Mass.
Deans, J. S.....Phœnixville, Pa.
Dennis, W. F..Washington, D. C.
Deyo, S. LeF.....New York City
Dilks, L. C.....New York City
Dimon, D. Y.....Passaic, N. J.
Dixon, G. G.....Akron, Ohio
Donham, B. C..Glen Ridge, N. J.
Dorrance, W. T.....Boston, Mass.
Dougherty, R. E..New York City
Dufresne, A. R.,
Ottawa, Ont., Canada
Duggan, G. H.,
Montreal, Que., Canada
Dunn, H. L..New London, Conn.
du Pont, Biderman,
Greenville, Del.
Durham, H. W....New York City

Earle, Thomas.....Steelton, Pa.
Easby, M. W....Philadelphia, Pa.
Eckersley, J. O....New York City
Eddy, H. P.....Boston, Mass.
Edmondson, R. S..New York City
Edwards, D. G....Brooklyn, N. Y.
Edwards, J. H.....Passaic, N. J.
Edwards, W. R....Baltimore, Md.
Ehrbar, L. H.....New York City
Ehrsam, Fritz.....New York City
Eide, Torris.....New York City
Ellendt, J. G....Rochester, N. Y.
Elliott, C. G...Washington, D. C.
Ellis, H. C...White Plains, N. Y.
Ellis, J. W.....Woonsocket, R. I.
Elwell, C. C...New Haven, Conn.
Ely, C. B.....Harrisburg, Pa.
Ely, G. W., Jr.....New York City
Endicott, M. T..Washington, D. C.
English, H. L.....New York City
Entenmann, P. M.,
Brooklyn, N. Y.
Evans, R. R.....Haverhill, Mass.

Farley, M. M..White Plains, N. Y.
Farnham, A. B...Pittsfield, Mass.
Fay, F. H.....Boston, Mass.

Federlein, W. G...New York City
Fehr, H. R.....Easton, Pa.
Fenton, L. G.....Brooklyn, N. Y.
Ferguson, J. N.....Boston, Mass.
Fetherston, J. T.,
New Brighton, N. Y.
Firth, E. W.....Jamaica, N. Y.
Fisher, E. A....Rochester, N. Y.
Fitch, C. L.....Brooklyn, N. Y.
FitzGerald, Desmond,
Brookline, Mass.
Fletcher, Robert..Hanover, N. H.
Flinn, A. D.....Yonkers, N. Y.
Follett, W. W.....El Paso, Tex.
Forbes, F. B,.....New York City
Ford, H. C.....New York City
Ford, W. H.....Philadelphia, Pa.
Foss, F. E.....New York City
Foster, E. H.....New York City
Fox, W. F.....New York City
Franklin, C. M....New York City
Fraser, C. E.....New York City
French, A. W...Worcester, Mass.
French, Halsey.....New York City
French, J. B.....New York City
Frost, G. S.....Brooklyn, N. Y.
Fuller, A. H.....Seattle, Wash.
Fuller, G. W.....New York City
Fulweiler, W. H.,
West Chester, Pa.
Furber, W. C....Philadelphia, Pa.

Gahagan, W. H...Brooklyn, N. Y.
Gandolfo, J. H....New York City
Gardiner, F. W....Yonkers, N. Y.
Gardner, Warren..New York City
Garfield, C. A.,
White Plains, N. Y.
Garrison, F. L..Philadelphia, Pa.
Gartensteig, Charles,
New York City
Gaston, L. P.....New York City
Gerber, Emil.....Pittsburgh, Pa.
Germer, W. E.....New York City
Gifford, G. E.....New York City
Giles, Robert.....New York City
Gillen, W. J.....New York City
Gillespie, R. H....New York City
Gilman, Charles..Plainfield, N. J.
Glander, J. H., Jr..New York City
Godfrey, S. C..West Point, N. Y.
Golding, T. W....Brooklyn, N. Y.
Goldsborough, J. B.,
New York City
Goodell, J. M.,
Upper Montclair, N. J.
Goodman, Joseph..New York City
Goodsell, D. B.....New York City
Gow, C. R.....Boston, Mass.
Graham, C. H.....New York City
Gray, J. L.....Bayonne, N. J.
Gray, William.....New York City
Greathead, J. F...New York City
Greene, Carleton...New York City
Greene, G. S., Jr..New York City
Greenlaw, R. W...New York City
Gregg, J. H. C...Brooklyn, N. Y.
Gregory, C. E....Mt. Kisco, N. Y.
Greiner, J. E.....Baltimore, Md.
Grimes, E. L.....Troy, N. Y.
Gutman, David....New York City

Haines, E. G....Brooklyn, N. Y.
Hale, H. M.....Brooklyn, N. Y.
Hale, R. A.....Lawrence, Mass.
Hall, M. W.....New York City
Hall, W. M..Parkersburg, W. Va.
Hallihan, J. P....New York City
Hallock, J. C.....Newark, N. J.
Halsey, W. H.,
Bridge Hampton, N. Y.
Hamilton, J. W...New York City
Hammel, E. F.....New York City
Hammond, J. F.,
Richmond Hill, N. Y.
Hanavan, W. L..Newburgh, N. Y.
Hansel, Charles...Cranford, N. J.
Harby, Isaac,
Richmond Hill, N. Y.
Harding, H. S...New York City

Haring, Alexander, New York City
Harrington, F. F....Norfolk, Va.
Harris, F. R.....Brooklyn, N. Y.
Harte, C. R...New Haven, Conn.
Hartman, A. F.....Nutley, N. J.
Hartwell, Harry..New York City
Harwi, S. J.....Bayonne, N. J.
Hasbrouck, Oscar..Albany, N. Y.
Haskins, W. J....New York City
Hathaway, C. M., New Bedford, Mass.
Hatton, T. C....Wilmington, Del.
Hauck, William...New York City
Hayes, R. D.....Stillwater, N. Y.
Hayes, S. W.....Richmond, Ind.
Hazard, Schuyler...Albion, N. Y.
Hazen, Allen.....New York City
Hazen, J. V.....Hanover, N. H.
Healy, J. R.....New York City
Heilbronner, L. C., Schenectady, N. Y.
Hench, N. M.....Pittsburgh, Pa.
Henderson, J. T..Hartford, Conn.
Hering, Rudolph...New York City
Hermanns, F. E...New York City
Hewes, V. H.....New York City
Heyman, William, Jersey City, N. J.
Higgins, C. H..Jersey City, N. J.
Higgins, J. W., Roselle Park, N. J.
Hildreth, J. L., Jr., Cornwall, N. Y.
Hill, A. B.....New Haven, Conn.
Hill, W. R.....Albany, N. Y.
Hillyer, W. R., Port Richmond, N. Y.
Hilton, J. C., Shelburne Falls, Mass.
Hilts, H. E..New Rochelle, N. Y.
Hines, H. E....Princeton, W. Va.
Hirst, Arthur.....Trenton, N. J.
Hitchcock, F. C...New York City
Hoag, S. W., Jr...New York City
Hodgdon, B. A....New York City
Hodge, H. W.....New York City
Hogan, J. P....High Falls, N. Y.
Holbrook, A. R....New York City
Holbrook, Percy....New York City
Holden, C. A....Hanover, N. H.
Holland, C. M....Brooklyn, N. Y.
Holtzman, S. F....New York City
Honness, G. G...Kingston, N. Y.
Hood, J. N.....Newburgh, N. Y.
Horne, H. W., New Hartford, Conn.
Houston, J. J. L...Jamaica, N. Y.
Hovey, O. E.....Plainfield, N. J.
Howard, L. T., Tompkinsville, N. Y.
Howard, O. Z.....New York City
Howe, C. E.....Hastings, N. Y.
Howell, D. J...Washington, D. C.
Howell, W. A.....Newark, N. J.
Howes, D. W.....Brooklyn, N. Y.
Hubbard, W. D., Brown Station, N. Y.
Hubbell, G. S.....New York City
Hudson, C. W....Montclair, N. J.
Hudson, H. W....New York City
Hughes, J. W.....Erie, Pa.
Hulsart, C. R.....New York City
Humphrey, R. L., Philadelphia, Pa.
Humphreys, D. C..Lexington, Va.
Hunt, C. A.....New York City
Hunt, Chas. Warren, New York City
Hunt, Robert W.....Chicago, Ill.
Hunt, W. H.....New York City
Hurd, H. L..White Plains, N. Y.
Hutchins, E. N....New York City
Hyde, J. L.....Westfield, Mass.

Ilsley, A. B....Washington, D. C.
Ives, A. S....Poughkeepsie, N. Y.
Ives, H. C.....Worcester, Mass.

James, A. R.....Elizabeth, N. J.
Janes, G. P.....Roselle, N. J.
Janvrin, N. H..Newburgh, N. Y.

Jarrett, E. S.....New York City
Jenkins, J. E.....New York City
Johannesson, Sigvald,
Upper Montclair, N. J.
Johnson, D. C....Brooklyn, N. Y.
Johnson, L. E.....Steelton, Pa.
Johnson, T. S.....Granville, Ohio
Johnston, J. A..Springfield, Mass.
Jones, W. A...New Haven, Conn.
Just, G. A.,
Long Island City, N. Y.

Karner, W. J.....New York City
Kastenhuber, E. G., Jr.,
Beverly, N. J.
Kaufman, Gustave,
New York City
Keays, R. H....New Paltz, N. Y.
Keefer, C. H.,
Ottawa, Ont., Canada
Keith, H. C.....New York City
Kelley, W. D.....Yonkers, N. Y.
Kershaw, W. H...New York City
Kimball, F. C.....Summit, N. J.
King, P. S.....Philadelphia, Pa.
Kinney, W. M....Pittsburgh, Pa.
Kinsey, W. A.....Newark, N. J.
Kirchner, P. A....New York City
Kirkwood, H. C..Flushing, N. Y.
Knap, E. D.....New York City
Knap, J. M.....Catskill, N. Y.
Knighton, J. A....New York City
Knox, S. B.....New York City
Kornfeld, A. E....New York City
Krellwitz, D. W...New York City
Kuchar, F. M....Brooklyn, N. Y.

La Chicotte, H. A.,
Brooklyn, N. Y.
Lamb, W. A.....Helena, Mont.
Lamson, W. M....New York City
Lanagan, F. R.....Albany, N. Y.
Landreth, O. H.,
Schenectady, N. Y.
Langthorn, J. S...New York City
Lannan, L. E.....New York City
Lant, F. P.....New York City
Larmon, F. P...Cambridge, N. Y.
Larsson, C. G. E...New York City
Latey, H. N.....New York City
Latimer, C. A.....New York City
Latta, H. W.....Philadelphia, Pa.
Law, W. H.....Woodside, N. Y.
Lee, E. M.....Paterson, N. J.
Leeper, J. B.....Pittsburgh, Pa.
Leete, P. R...Short Beach, Conn.
Leeuw, H. A.....New York City
Leighton, George...Glenburn, Pa.
Leonard, H. R...Philadelphia, Pa.
Leser, Henry.....New York City
Lesley, R. W....Philadelphia, Pa.
Letson, T. H.....New York City
Lewis, Clifford, Jr...Utica, N. Y.
Lewis, E. W...New Haven, Conn.
Lewis, J. O.....Brooklyn, N. Y.
Lewis, N. P.....New York City
Lex, W. I.....Philadelphia, Pa.
Lichtner, W. O.,
Newton Highlands, Mass.
Lobo, Carlos.....Brooklyn, N. Y.
Loewenstein, Jacob,
New York City
Logan, W. S.....Newark, N. J.
Look, M. J..Brown Station, N. Y.
Loomis, Horace,
Mt. Vernon, N. Y.
Lowinson, Oscar...New York City
Lucas, E. W. V. C..New York City
Lucius, Albert.....New York City
Lueder, A. B.....New York City
Lund, G. A.....New York City
Lyle, W. T.....Easton, Pa.
Lynde, Clifford....Walden, N. Y.

MacCracken, G. G..New York City
Macdonald, Charles,
Brooklyn, N. Y.
MacFeeters, J. O..New York City
MacGregor, R. A..New York City
Machen, H. B.....New York City
Mackenzie, K. G..Bayonne, N. J.
Macnab, G. T.....New York City

McCurdy, H. S. R.,
Brown Station, N. Y.
McGlashan, H. D..Berkeley, Cal.
McIntyre, W. A..Philadelphia, Pa.
McKenzie, T. H.,
Southington, Conn.
McKibbon, F. P.,
South Bethlehem, Pa.
McLure, N. R...Phœnixville, Pa.
McMinn, T. J....Brooklyn, N. Y.
McMullen, R. W..New York City
McNaugher, D. W.Pittsburgh, Pa.
Malmros, N. L....New York City
Malmros, N. L. A..Yonkers, N. Y.
Maltby, F. B.....New York City
Manahan, E. G....New York City
Manley, L. B.,
West Roxbury, Mass.
Marple, W. McK...Scranton, Pa.
Marsh, A. L.....Newark, N. J.
Marsh, F. B.....New York City
Marshall, R. A....Cranford, N. J.
Mason, Francis...New York City
Mazeau, Camille..Brooklyn, N. Y.
Mead, C. A.,
Upper Montclair, N. J.
Meadowcroft, William,
New York City
Meem, J. C.....Brooklyn, N. Y.
Meggy, R. L. G...Fanwood, N. J.
Mehren, E. J.....New York City
Melius, L. L.....New York City
Mercer, C. H.....Steelton, Pa.
Merriman, Mansfield,
New York City
Merriman, Thaddeus,
Essex Fells, N. J.
Merritt, C. E.....Utica, N. Y.
Meriwether, Coleman,
New York City
Metcalf, Leonard...Boston, Mass.
Middlebrook, C. T..Albany, N. Y.
Miles, G. F.....New York City
Miller, H. A.....Boston, Mass.
Miller, Hugh.....Potsdam, N. Y.
Miller, M. M.....Yonkers, N. Y.
Miller, S. O.....New York City
Miller, Spencer.....New York City
Minor, E. E...New Haven, Conn.
Mitchell, C. H.,
Toronto, Ont., Canada
Mitchell, S. P...Philadelphia, Pa.
Modjeski, Ralph.....Chicago, Ill.
Mogensen, O. E..Plainfield, N. J.
Moisseiff, L. S.....New York City
Molitor, D. A.....Detroit, Mich.
Molitor, Frederic...New York City
Móller, Louis,
Ft. William, Ont., Canada
Moore, E. J.....New York City
Moore, F. F....Hawthorne, N. Y.
Moore, W. H..New Haven, Conn.
Morrill, G. S....Dorchester, Mass.
Morrison, H. J...Prospect, N. Y.
Morrison, R. L....New York City
Morse, C. F.....Wallkill, N. Y.
Mott, W. E.....Pittsburgh, Pa.
Moyer, Albert.....New York City
Muir, A. W.....Newton, N. J.
Muller, Leslie.....New York City
Munkelt, F. H....Brooklyn, N. Y.
Murphy, J. J.....Detroit, Mich.
Myers, C. H.....New York City

Nagle, J. C..College Station, Tex.
Najjar, S. A.....Brooklyn, N. Y.
Neely, J. T.,
Gatun, Canal Zone, Panama
Neely, W. R....New Paltz, N. Y.
Neff, F. H.....Cleveland, Ohio
Nelson, J. A.....Paterson, N. J.
Neuhardt, Edwin..New York City
Neumeyer, R. E...Bethlehem, Pa.
Newcomb, W. T.....Easton, Pa.
Newhall, H. L...New Paltz, N. Y.
Newman, A. T....New York City
Nichols, C. H..New Haven, Conn.
Noble, Alfred.....New York City
Norris, W. H.....Portland, Me.

Ockerson, J. A.....St. Louis, Mo.
O'Connell, G. P.,
Brown Station, N. Y.

Odell, F. S...Port Chester, N. Y.
Oestreich, H. L...Brooklyn, N. Y.
Ogden, J. C.....New York City
Okeson, W. R...Glen Ridge, N. J.
O'Rourke, J. F....New York City
Orrok, G. A.....Brooklyn, N. Y.
Ott, S. J.....Rutherford, N. J.
Owen, James.....Newark, N. J.
Owen, K. D.....Montclair, N. J.
Oxholm, T. S.,
West New Brighton, N. Y.

Pagon, W. W.....Baltimore, Md.
Parker, C. J.....New York City
Parker, J. L.....New York City
Parsons, G. W.....Steelton, Pa.
Parsons, H. de B..New York City
Pawling, G. F...Philadelphia, Pa.
Payrow, H. G.,
Tufts College, Mass.
Peabody, W. W.,
White Plains, N. Y.
Pegram, G. H.....New York City
Pelz, C. E.....New York City
Pemoff, J. J.....New York City
Pendlebury, Edward,
Arlington, N. J.
Perkins, P. S....Providence, R. I.
Perkins, W. W. C.,
Niagara Falls, N. Y.
Perry, L. E.....Salisbury, Md.
Philips, J. H...Glen Ridge, N. J.
Phillips, A. E..Washington, D. C.
Phillips, H. C.....Chicago, Ill.
Pierce, T. D.,
Cambridge Springs, Pa.
Pitcher, S. H....Worcester, Mass.
Pitkethly, D. T....Jamaica, N. Y.
Pohl, C. A.....New York City
Polk, W. A.....New York City
Poole, C. A.....Rochester, N. Y.
Post, H. W.,
Mountain Lakes, N. J.
Potter, H. L.....Brooklyn, N. Y.
Powers, C. V. V...New York City
Pratt, A. H...White Plains, N. Y.
Pratt, M. D.....Harrisburg, Pa.
Preston, C. H.....Norwich, Conn.
Preston, C. H., Jr.,
Waterbury, Conn.
Preston, H. L.....Jordan, N. Y.
Price, F. O.....Brooklyn, N. Y.
Price, P. L.....Flushing, N. Y.
Prichard, H. S....Pittsburgh, Pa.
Priest, B. B...East Orange, N. J.
Purdy, S. M.....Brooklyn, N. Y.

Quimby, H. H..Philadelphia, Pa.
Quinn, M. F.....New York City

Raff, H. G.....New York City
Randorf, C. A....Hamburg, N. Y.
Rankin, E. S.....Newark, N. J.
Reeves, W. F.....New York City
Reid, H. A.....New York City
Reimer, A. A..East Orange, N. J.
Reimer, F. A..East Orange, N. J.
Remsen, T. R....Brooklyn, N. Y.
Reukauf, W. C...Brooklyn, N. Y.
Rice, G. S.....New York City
Rich, M. S.....Washington, D. C.
Richardson, Clifford,
New York City
Richardson, J. H...Boston, Mass.
Richmond, J. P. W.,
Yonkers, N. Y.
Ridgway, Robert..New York City
Riegler, L. J.....Ben Avon, Pa
Rights, L. D.....New York City
Ripley, Joseph.....Albany, N. Y.
Ripley, T. M.....Fulton, N. Y.
Robbins, F. H.,
White Plains, N. Y.
Roberts, H. W.....New York City
Roberts, R. F.....New York City
Robinson, E. W....New York City
Rogers, A. W.....Buffalo, N. Y.
Rogers, E. H.,
West Newton, Mass.
Rogers, H. L.....New York City

Rogge, J. C. L.....New York City
Rohrer, Grant.....New York City
Rollins, J. W., Jr...Boston, Mass.
Roper, R. M...East Orange, N. J.
Rose, R. V...Niagara Falls, N. Y.
Rosenberg, F.....Montclair, N. J.
Rossi, Irving...Jersey City, N. J.
Rudolph, W. E...Brooklyn, N. Y.
Rugg, W. F.....Peekskill, N. Y.
Ruggles, A. V.....New York City
Rust, H. P.....New York City
Ryan, M. H.....New York City
Ryder, E. M. T....Yonkers, N. Y.

Sanborn, F. B.,
Tufts College, Mass.
Sanborn, J. F....Cornwall, N. Y.
Sanborn, M. F.,
Pleasantville, N. Y.
Sargent, P. D..Washington, D. C.
Saville, Charles....New York City
Sayles, R. W.....New York City
Schaeffer, Amos....New York City
Schall, F. E.,
South Bethlehem, Pa.
Schermerhorn, H. O.,
Albany, N. Y.
Schneider, C. C..Philadelphia, Pa.
Schreiber, J. M.....Newark, N. J.
Schroeder, F. C....New York City
Schwarze, C. T....New York City
Seaman, H. B.....New York City
Searight, G. P.,
White Plains, N. Y.
Searle, C. D.....New York City
Seaver, Clifford,
East Orange, N. J.
Senior, F. S...Montgomery, N. Y.
Serber, D. C.....New York City
Shailer, R. A.....Boston, Mass.
Shaughnessy, C. S.,
Cold Spring, N. Y.
Shaw, D. J.....Katonah, N. Y.
Shaw, F. H.....Lancaster, Pa.
Shaw, G. H.....Brooklyn, N. Y.
Shepherd, F. C.....Boston, Mass.
Sheridan, L. V..Indianapolis, Ind.
Sherman, A. L.,
White Plains, N. Y.
Sherman, C. W.....Boston, Mass.
Sherrerd, J. M.....Easton, Pa.
Shoemaker, M. N..Newark, N. J.
Sickman, A. F....Holyoke, Mass.
Sikes, Z. H.....Yonkers, N. Y.
Simpson, G. F....New York City
Sitt, W. T.....New York City
Skillin, E. S.....New York City
Skinner, F. W.....New York City
Skinner, J. F....Rochester, N. Y.
Sloan, W. G.....New York City
Slocum, C. M...Springfield, Mass.
Smith, A. C., Jr...Baltimore, Md.
Smith, Augustus...Bayonne, N. J.
Smith, C. E.,
West New Brighton, N. Y.
Smith, C. H....Middletown, N. Y.
Smith, C. W.....New York City
Smith, J. R.....New York City
Smith, J. W.....New York City
Smith, M. H.....New York City
Smith, W. F.....Valhalla, N. Y.
Smith, W. M.,
West New Brighton, N. Y.
Smoley, C. K.....Scranton, Pa.
Snell, H. B.....Brooklyn, N. Y.
Snow, J. B..Richmond Hill, N. Y.
Snow, J. P.,
West Somerville, Mass.
Snyder, C. H.....Oswego, N. Y.
Snyder, F. A.....New York City
Snyder, G. D.....New York City
Soest, H. C.....New York City
Soper, G. A.....New York City
Spaulding, F. A..Pittsfield, Mass.
Spear, W. E.....New York City
Spencer, C. B.....New York City
Splitstone, C. H.,
East Orange, N. J.
Spofford, C. M.....Boston, Mass.
Spooner, A. N...New Dorp, N. Y.

Stanford, H. R., Washington, D. C.
Staniford, C. W...New York City
Sprague, E. L., Jr..Valhalla, N. Y.
Stark, C. W.....New York City
Starr, F. C.....Washington, D. C.
Starr, H. H.....New York City
Stearns, F. L.....New York City
Stearns, F. P.....Boston, Mass.
Stearns, R. H....Hartford, Conn.
Steffens, W. F.....Boston, Mass.
Stehle, F. C....Mt. Vernon, N. Y.
Stephens, A. W., East Orange, N. J.
Stephenson, F. H..New York City
Stern, E. W.....New York City
Stevens, H. C.....New York City
Stevenson, W. F., New Rochelle, N. Y.
Stewart, J. M.....New York City
Stoddard, G. C....New York City
Stoddard, R. F..Bridgeport, Conn.
Stone, W. W....Newburgh, N. Y.
Stott, H. G.....New York City
Strachan, Joseph..Brooklyn, N. Y.
Strawn, T. C.....New York City
Strickler, F. W., Mt. Vernon, N. Y.
Strong, J. B.....Hillburn, N. Y.
Strouse, W. F.....Baltimore, Md.
Sullivan, J. F.....New York City
Sutton, Frank..Washington, D. C.
Swaab, S. M....Philadelphia, Pa.
Swain, G. F.....Boston, Mass.
Swezey, E. C....Brooklyn, N. Y.
Swindells, J. S...Brooklyn, N. Y.

Taber, G. A.....Brooklyn, N. Y.
Taft, J. R.....New York City
Taggart, R. C....Brooklyn, N. Y.
Tait, Harold, Long Island City, N. Y.
Talbot, A. N.....Urbana, Ill.
Taylor, C. F.....New York City
Taylor, G. McC..Red Bank, N. J.
Tays, E. A. H., San Blas, Sinaloa, Mexico
Temple, W. H. G.Providence, R. I.
Tenney, W. R....Brooklyn, N. Y.
Terry, J. H.....Philadelphia, Pa.
Thacher, Edwin...New York City
Thayer, N. A....New York City
Thoma, Jacob, Long Island City, N. Y.
Thomas, C. D....Brooklyn, N. Y.
Thomes, E. H.....Jamaica, N. Y.
Thompson, J. A..New York City
Thompson, S. C..New York City
Thompson, S. E., Newton Highlands, Mass.
Thomson, Alexander, Jr., Walden, N. Y.
Thomson, John...New York City
Thomson, S. F..New Paltz, N. Y.
Thomson, T. K...New York City
Thurber, C. D....Brooklyn, N. Y.
Tidd, A. W...White Plains, N. Y.
Tighe, J. L.....Holyoke, Mass.
Tillson, G. W....Brooklyn, N. Y.
Tilt, G. E.....New York City
Timberlake, S. M., White Plains, N. Y.
Tinker, C. A.....Westfield, Mass.
Tompkins, E. DeV..Pelham, N. Y.
Torrey, J. E.....Paterson, N. J.
Tower, J. W.....New York City
Tozzer, A. C.....New York City
Trautwine, J. C., Jr., Philadelphia, Pa.
Tretter, G. A.....Roanoke, Va.
Tribus, L. L.....New York City
Triest, W. G.....New York City
Trout, C. E.....New York City
Trow, F. H..Brown Station, N. Y.
Trowbridge, D. S..New York City
True, A. O.....Albany, N. Y.
Tull, R. W.....Fanwood, N. J.
Turner, D. L.....New York City
Turner, E. K.....Boston, Mass.
Tuska, G. R.....New York City

Tuttle, A. S.....New York City
Tyler, W. R.....New York City

Upson, M. M....Englewood, N. J.

Valleley, W. P...New York City
Van Cleve, A. H..New York City
Van Horne, J. G.New York City
Van Norden, E. M.,
Brooklyn, N. Y.
Van Winkle, Edward,
New York City
Vaughan, L. B...Kingston, N. Y.
Verveer, E. L.....New York City
Vincent, J. I.....New York City
Vrooman, Morrell,
Gloversville, N. Y.

Wachter, C. L....New York City
Waddell, F. C.,
West New Brighton, N. Y.
Wagner, J. C....Philadelphia, Pa.
Wait, B. H.....New York City
Waite, G. B.....New York City
Walker, E. L.....New York City
Wallace, J. F.....New York City
Ward, C. D.....New York City
Wardle, E. B..West Nutley, N. J.
Warnock, W. H...New York City
Watkins, F. W.,
White Plains, N. Y.
Watt, D. A.....New York City
Watters, G. L.,
South Bethlehem, Pa.
Webster, G. S...Philadelphia, Pa.
Wegmann, Edward,
New York City
Wells, C. E...White Plains, N. Y.
Wells, G. E....Naugatuck, Conn.
Wendt, E. F.....Pittsburgh, Pa.
Wentworth, C. A.....Wayne, Pa.
Wentworth, G. L..Yonkers, N. Y.
Weston, F. S...Middleboro, Mass.
Weston, R. S.....Boston, Mass.
Whinery, Samuel,
East Orange, N. J.
Whipple, G. C....New York City
Whiskeman, J. P..New York City
White, Lazarus...New York City
White, T. S.....Beaver Falls, Pa.
Whitney, F. O.....Boston, Mass.
Whittemore, J. O.,
Mt. Vernon, N. Y.
Wiggin, E. W..New Haven, Conn.
Wiggin, T. H....Scarsdale, N. Y.
Wilcock, Frederick,
Brooklyn, N. Y.
Wilcox, Frank....Pittsburgh, Pa.
Wild, H. J.....Chester, Pa.
Wildes, W. G....Rochester, N. Y.
Wiley, W. H..East Orange, N. J.
Williams, E. G....New York City
Williams, F. P.,
Mechanicsville, N. Y.
Williams, Frederick,
New London, Conn.
Williams, G. S..Ann Arbor, Mich.
Willis, A. J.....New York City
Wills, W. S.....Neligh, Nebr.
Wilmot, James....New York City
Wilmot, Sydney..New York City
Wilson, C. W. S.,
New Rochelle, N. Y.
Wilson, H. M.....Pittsburgh, Pa.
Wilson, P. H....Philadelphia, Pa.
Wilson, T. L.....New York City
Wilson, W. T.....New York City
Wilson, William..New York City
Winsor, F. E.White Plains, N. Y.
Winsor, G. A.....Valhalla, N. Y.
Winsor, H. D.....New York City
Wise, C. R.....Passaic, N. J.
Witmer, F. P..East Orange, N. J.
Wolcott, C. S.....Hornell, N. Y.
Wolfe, F. G.....Scranton, Pa.
Wolff, A. D., Jr....New York City
Wolverton, I. M.,
Mt. Vernon, Ohio
Wood, G. P.....Peekskill, N. Y.

Wood, H. S.....New York City
Wood, I. S.....Providence, R. I.
Woodard, S. H..Scarsdale, N. Y.
Worthington, Charles,
New York City
Wright, J. B.....New York City
Wyckoff, C. R.,
White Plains, N. Y.
Wyman, A. M....New York City
Yappan, Adolph.....Chicago, Ill.
Yates, P. K.....Brooklyn, N. Y.
Yates, W. H.....Albany, N. Y.
Yereance, W. B...New York City
Zook, M. A.....Plainfield, N. J.

PROGRESS REPORT OF SPECIAL COMMITTEE ON CONCRETE AND REINFORCED CONCRETE.

I. Introduction.

1.—Appointment and Work of Committee.

In 1903 and 1904 Special Committees were appointed by the American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering and Maintenance of Way Association, and the Association of American Portland Cement Manufacturers, for the purpose of investigating current practice and providing definite information concerning the properties of concrete and reinforced concrete and to recommend necessary factors and formulas required in the design of structures in which these materials are used. The history of the appointment of the committees is as follows:

At the Annual Convention of the American Society of Civil Engineers, held at Asheville, N. C., June 11th, 1903, the following resolution was adopted:

"It is the sense of this meeting that a Special Committee be appointed to take up the question of concrete and steel-concrete, and that such committee co-operate with the American Society for Testing Materials, and the American Railway Engineering and Maintenance of Way Association."

Following the adoption of this resolution, a Special Committee on Concrete and Steel-concrete was appointed by the Board of Direction on May 31st, 1904. At the Annual Meeting, held January 18th, 1905, the title of this Special Committee was, at the request of the Committee, changed to "Special Committee on Concrete and Reinforced Concrete." This Special Committee held its first meeting at Atlantic City, N. J., June 17th, 1904, and effected an organization; Mr. C. C. Schneider was appointed Chairman and Mr. J. W. Schaub, Secretary. Mr. Schneider resigned from the Committee on January 3d, 1911, and the Board of Direction, on January 31st, 1911, appointed Mr. J. R. Worcester as Chairman. On the resignation of Mr. J. W. Schaub, Mr. Richard L. Humphrey was appointed Secretary on October 11th, 1905.

At the first meeting of the Committee it was decided to co-operate with similar committees which had been appointed by the American Society for Testing Materials and the American Railway Engineering and Maintenance of Way Association through the organization of a Joint Committee on Concrete and Reinforced Concrete.

Subsequent meetings of the Committee were held at New York in January, 1906, 1907, 1909, 1910, 1911, and 1912; on December 10th,

1907; on March 1st, April 3d, May 1st, 1911, and on November 20th, 1912; at Philadelphia in December, 1908; and at Chicago in June, 1910. The Committee was also represented at all the meetings of the Joint Committee.

At the annual meeting of the American Society for Testing Materials, held on July 1st, 1903, at the Delaware Water Gap, the following resolution was unanimously adopted:

"That the Executive Committee be requested to consider the desirability of appointing a committee on 'Reinforced Concrete', with a view of co-operating with the committees of other societies in the study of the subject."

At the meeting of the Executive Committee of the American Society for Testing Materials, held on December 5th, 1903, a special committee on "Reinforced Concrete" was appointed.

The American Railway Engineering and Maintenance of Way Association appointed a Committee on Masonry on July 20th, 1899, with instructions, as a part of its duties, to prepare specifications for concrete masonry. A preliminary set of specifications for Portland cement concrete was reported to and adopted by the Association on March 19th, 1903. At the meeting held in Chicago on March 17th, 1904, the Committee on Masonry was authorized to co-operate with the Special Committee on Concrete and Reinforced Concrete of the American Society of Civil Engineers, and, following this action, a special sub-committee was appointed.

At a meeting of the several special committees representing the above-mentioned societies, held at Atlantic City, N. J., on June 17th, 1904, arrangements were completed for collaborating the work of these several committees through the formation of the Joint Committee on Concrete and Reinforced Concrete. Mr. C. C. Schneider was elected temporary chairman and Professor A. N. Talbot temporary secretary. The proposed plan of action of the Special Committee of the American Society of Civil Engineers was outlined, involving the appointment of sub-committees on Plan and Scope, on Tests, and on Ways and Means.

The Joint Committee, at its first meeting, invited the Association of American Portland Cement Manufacturers to join in its deliberations through a committee appointed for the purpose.

The Joint Committee, at meetings at St. Louis in October, 1904, and at New York in the following January, perfected its organization by the adoption of rules and the choice of Mr. C. C. Schneider as Chairman, Mr. Emil Swensson, Vice-Chairman, and Mr. J. W. Schaub, Secretary. Later, on the resignation of Mr. Schaub, Mr. Richard L. Humphrey was chosen Secretary. Sub-committees on Plan and Scope, on Tests, and on Ways and Means were appointed.

The Joint Committee, as thus organized, consisted of the following members:

OFFICERS.

Chairman.—C. C. SCHNEIDER.
Vice-Chairman.—EMIL SWENSSON.
Secretary.—RICHARD L. HUMPHREY.

MEMBERS.

American Society of Civil Engineers (Special Committee on Concrete and Reinforced Concrete):

Greiner, J. E., Consulting Engineer, Baltimore and Ohio Railroad, Baltimore, Md.
Hatt, W. K., Professor of Civil Engineering, Purdue University, Lafayette, Ind.
Hoff, Olaf, Vice-President, Butler Brothers, Hoff and Company, New York, N. Y.
Humphrey, Richard L., Consulting Engineer; Engineer in Charge, Structural Materials Testing Laboratories, U. S. Geological Survey, Philadelphia, Pa.
Lesley, R. W., President, American Cement Company, Philadelphia, Pa.
Schaub, J. W., Consulting Engineer, Chicago, Ill.
Schneider, C. C., Consulting Engineer, Philadelphia, Pa.
Swensson, Emil, Consulting Engineer, Pittsburgh, Pa.
Talbot, A. N., Professor of Municipal and Sanitary Engineering, in Charge of Theoretical and Applied Mechanics, University of Illinois, Urbana, Ill.
Worcester, J. R., Consulting Engineer, Boston, Mass.

American Society for Testing Materials (Committee on Reinforced Concrete):

Fuller, William B., Consulting Engineer, New York, N. Y.
Heidenreich, E. Lee, Consulting Engineer, New York, N. Y.
Humphrey, Richard L., Consulting Engineer; Engineer in Charge, Structural Materials Testing Laboratories, U. S. Geological Survey, Philadelphia, Pa.
Johnson, Albert L., Consulting Engineer, St. Louis, Mo.
Lanza, Gaetano, Professor of Theoretical and Applied Mechanics, Massachusetts Institute of Technology, Boston, Mass.
Lesley, R. W., President, American Cement Company, Philadelphia, Pa.
Marburg, Edgar, Professor of Civil Engineering, University of Pennsylvania, Philadelphia, Pa.
Mills, Charles M., Principal Assistant Engineer, Philadelphia Rapid Transit Company, Philadelphia, Pa.
Moisseiff, Leon S., Engineer of Design, Department of Bridges, New York, N Y.

Quimby, Henry H., Assistant Engineer of Bridges, Bureau of Surveys, Philadelphia, Pa.
Taylor, W. P., Engineer in Charge of Testing Laboratory, Philadelphia, Pa.
Thompson, Sanford E., Consulting Engineer, Newton Highlands, Mass.
Turneaure, F. E., Dean of College of Mechanics and Engineering, University of Wisconsin, Madison, Wis.
Wagner, Samuel Tobias, Assistant Engineer, Philadelphia and Reading Railroad, Philadelphia, Pa.
Webster, George S., Chief Engineer, Bureau of Surveys, Philadelphia, Pa.

American Railway Engineering Association (Sub-Committee on Reinforced Concrete):

Beckwith, Frank, Engineer of Bridges and Structures, Lake Shore and Michigan Southern Railroad, Cleveland, Ohio.
Boynton, C. W., Inspecting Engineer, Cement Department, Illinois Steel Company, Chicago, Ill.
Cunningham, A. O., Chief Engineer, Wabash Railroad, St. Louis, Mo.
Scribner, Gilbert H., Jr., Contracting Engineer, Chicago, Ill.
Swain, George F., Professor of Civil Engineering, Massachusetts Institute of Technology, Boston, Mass.

Association of American Portland Cement Manufacturers (Committee on Concrete and Steel Concrete):

Fraser, Norman D., President, Chicago Portland Cement Company, Chicago, Ill.
Griffiths, R. E., Vice-President, American Cement Company, Philadelphia, Pa.
Hagar, Edward M., Manager, Cement Department, Illinois Steel Company, Chicago, Ill.
Newberry, Spencer B., Manager, Sandusky Portland Cement Company, Sandusky, Ohio.

Since organization, the following changes have occurred in the *personnel* of the Joint Committee:

J. W. Schaub, died March 30th, 1909.
C. C. Schneider, resigned January 3d, 1911.
Ernest R. Ackerman, resigned.
T. J. Brady, resigned.
Frank Beckwith, resigned.
A. O. Cunningham, resigned.
George F. Swain, resigned.

The following representatives of the American Railway Engineering Association have since been appointed:

Thompson, F. L., Engineer of Bridges and Buildings, Illinois Central Railroad, Chicago, Ill.

Alternates:

Hotchkiss, L. J., Assistant Bridge Engineer, Chicago, Burlington and Quincy Railroad, Chicago, Ill.

Prior, J. H., Assistant Engineer, Chicago, Milwaukee and St. Paul Railway, Chicago, Ill.

Schall, F. E., Bridge Engineer, Lehigh Valley Railroad, South Bethlehem, Pa.

Tuthill, Job, Assistant Engineer, Cincinnati, Hamilton and Dayton Railway, Cincinnati, Ohio.

At a meeting of the Joint Committee held at Atlantic City, N. J., on June 30th, 1911, Mr. J. R. Worcester was elected Chairman.

Meetings of the Joint Committee have been held as follows:

June 17th, 1904, at Atlantic City, N. J.
Oct. 4th, 5th, 6th, 1904, at St. Louis, Mo.
Jan. 17th, 1905, at New York, N. Y.
June 21st, 1905, at Cleveland, Ohio.
June 30th, 1905, at Atlantic City, N. J.
Oct. 11th, 1905, at New York, N. Y.
Dec. 14th, 1905, at New York, N. Y.
June 21st, 1906, at Atlantic City, N. J.
Dec. 13th, 1906, at New York, N. Y.
Jan. 15th, 1907, at New York, N. Y.
March 7th, 1907, at New York, N. Y.
March 18th, 1907, at Chicago, Ill.
June 21st, 22d, 1907, at Atlantic City, N. J.
Dec. 10th, 1907, at New York, N. Y.
Oct. 27th, 28th, 1908, at New York, N. Y.
Dec. 9th, 10th, 11th, 1908, at Philadelphia, Pa.
June 30th, 1911, at Atlantic City, N. J.
Nov. 20th, 1912, at New York, N. Y.

At the meeting of the Joint Committee at St. Louis in October, 1904, it was determined to arrange tests at such technological institutions as were provided with the requisite facilities and were willing to co-operate, the Committee, through its sub-committee on Ways and Means, to provide materials, and through its sub-committee on Tests, to consult as to lines of testing and to advise as to methods. The following ten institutions, Case School of Applied Science, Columbia University, Cornell University, University of Illinois, State University of Iowa, Massachusetts Institute of Technology, University of Minne-

sota, Ohio State University, Purdue University, and University of Wisconsin, undertook a preliminary series of tests, and carried them through, in due time reporting their results to the Committee.

Through the inability of the Committee to do as much as it had hoped by way of furnishing uniform materials for these tests and exercising a proper supervision, the results were not as serviceable as they would have been if the full plans had been carefully carried out; but much important information was received in this manner, and the Committee desires to express its gratitude to the professors and students who assisted so kindly in this work.

The results were collated and edited by the Secretary of the Committee at the Structural Materials Testing Laboratories of the U. S. Geological Survey, St. Louis, and the results, in typewritten form, were circulated among the members of the Committee. It was hoped that they might be published by the Geological Survey as a Bulletin, but in that the Committee was disappointed, though some of the results have been published in bulletins and papers issued by their authors.

In June, 1905, the U. S. Geological Survey proposed to co-operate with the Joint Committee to the extent of placing the tests made at the St. Louis Laboratory at its service and allowing the Committee the privilege of advising as to what tests of concrete and reinforced concrete should be conducted there. This co-operation was welcomed by the Committee, and was brought about by the fact that the Secretary of the Committee, who was also the Chairman of the sub-committee on tests, was in charge of the St. Louis Laboratory.

During the five years in which the investigations of structural materials were in progress under the direction of the United States Geological Survey, a large amount of data relating to concrete and reinforced concrete was obtained. These investigations have included the survey of the constituent materials of concrete, such as sands, gravels, and crushed stone, in the various parts of the United States, covering their strength as mortars or concretes in various consistencies and proportions.

A number of series of tests of plain and reinforced concrete beams was made, covering the influence of character of aggregates, proportions and age, percentage of reinforcement, the effect of the variation in span relative to the depth, methods of anchorage of the reinforcement, etc., upon strength. A study was made of the effect of the personal equation in tests of beams, made by three construction companies operating in St. Louis, and by the employees of the testing laboratory. Tests covering bond, shear, compressive strength, and weight per cubic foot, for various classes of aggregates, were made.

Among other investigations were tests of reinforced concrete slabs of 12 ft. span, supported at two and four edges, strength and other properties of cement hollow building blocks, of the permeability of

cement mortars and concretes, value of various water-proofing and damp-proofing preparations, effect of alkali and sea water on cement mortars and concretes, the fire-resistive properties of concrete and other structural materials, and these have been made and published, in part.

The collation and study of the data obtained were seriously handicapped through lack of funds available for this purpose, the large part of the appropriation being devoted to work urgently required by the various Government Bureaus. Of the annual Government appropriation of $100 000, there was never available more than $15 000 per annum for the investigation of concrete and reinforced concrete, and for several years the amount did not exceed $5 000 a year. None of this was available for the publication of results, and the allotment from the funds provided for all Government printing was wholly inadequate for the purpose.

On June 30th, 1910, Congress transferred this work to the Bureau of Standards, together with the data collected. It is understood that arrangements have been made by which the data of the tests will be published as rapidly as conditions permit.

The Committee has had the benefit of the results of investigations by a number of laboratories, some of which were under the direct supervision of its members. The extent and varied character of the tests, and their interpretation by those in charge, made them of especial value to the Committee.

The Committee also has had the advantage of investigations made in foreign laboratories.

At a meeting of the Joint Committee at Atlantic City, on June 30th, 1905, it was decided to divide among its members the work of collating and digesting the results of all available tests on concrete and reinforced concrete, and, in pursuance of this resolution, sub-committees were appointed on the following subjects:

Historical.
Aggregates, Proportions and Mixing.
Physical Characteristics, Water-proofing, etc.
Strength and Elastic Properties.
Simple Reinforced Concrete Beams.
T-Beams, Floor Slabs, etc.
Columns and Piles.
Fire-resistive Qualities.
Failures of Concrete Structures.
Arches.

A large amount of work was done by these sub-committees and extensive reports were submitted by most of them. These reports were typewritten in manifold and circulated among the members of

the Joint Committee, and were of great value to the Committee in arriving at its conclusions.

The Sub-Committee on Ways and Means raised by subscription about $8 000, which was used for preliminary investigations and expenses incident to printing its report and carrying on the work of the Committee. The Committee desires to express its appreciation for contributions and for donations of materials.

Even with this support, the field of activity of the Committee has been limited in scope, and it has been unable to undertake investigations of its own.

In 1908 the Committee began the preparation of the Progress Report which was submitted to the Society in January, 1909. A preliminary outline was prepared by the Secretary and submitted to the Committee in October. On October 27th, a meeting of the Joint Committee was held at New York, at which the report was discussed paragraph by paragraph, and chapters were referred to sub-committees and carefully revised during the following three weeks. The whole, as thus amended and revised, was again submitted in print to a full meeting held at Philadelphia, on December 9th, 10th, and 11th, and again was gone over in great detail. As a result of those two meetings, a considerable amount of matter, which it was at first intended to include, was omitted on account of slight disagreements as to its form and lack of time to work it into satisfactory shape, and to this fact may be attributed some of the criticisms which have been elicited It is hoped, in this report, to avoid these objections.

In the spring of 1911 the work of revising the 1909 Progress Report was taken up, and a number of meetings were held. The discussions submitted to the American Society of Civil Engineers and subsequent papers relating to the same subject were carefully considered, and differences of opinion between members of the Committee were threshed out.

Through the co-operation of the societies represented on the Joint Committee, the report was again put in type, and the necessary editions were printed for the use of the members of the Committee, the last bearing the date of August 1st, 1911. In the form thus reached, the report remained until November 20th, 1912, when the Committee again met in New York and gave the final review needed to bring it into the shape in which it is now presented.

2.—Historical Sketch of Use of Concrete and Reinforced Concrete.

In considering the history of concrete and reinforced concrete, a distinction should be made between the two. The use of concrete extends back to long before the Christian era—on the other hand, the art of reinforced concrete is in its infancy.

The use of concrete by the ancient Romans was due to the discovery of the fact that volcanic ash or puzzolan, when mixed with slaked lime, made a cement possessing hydraulic properties. The durability of this work of the Romans was due largely to favorable climatic conditions and the character of the cement used.

From the downfall of the Roman Empire to the last half of the Eighteenth Century the manufacture of cement seems to have been discontinued. The Roman cement mortars and concretes surviving the ravages of the elements became so hard that the cement acquired a reputation that led the early experimenters of the Eighteenth Century to seek to recover this supposedly lost Roman art. Evidently, no concrete was used during this period, for the necessity of simultaneous induration in the interior and exterior of the mass prevents the use of lime alone in concrete, and requires the use of some material having hydraulic qualities. This fact limited the use of concrete to regions where hydraulic limes and cements were to be found.

In 1756 Smeaton discovered that an argillaceous limestone produced a lime that would set and harden under water, but no immediate appreciation of this knowledge appears to have resulted.

Natural cement was first manufactured by Parker in 1795, as a result of an attempt to equal or excel Roman cement, and in 1796 he took out an English patent. Natural cement was first produced in America in 1818, and for a long time was the principal cement used. With the introduction of Portland cement, and the reduction in the cost of manufacture, there has been a gradual substitution of Portland for natural cement. The production of natural cement reached a maximum of nearly 10 000 000 bbl. in 1899 and gradually decreased to about 9 000 000 bbl. in 1911.

The art of manufacturing Portland cement was discovered in 1811 by Joseph Aspdin, and patented by him in 1824. He called this cement "Portland" by reason of its resemblance to a building stone obtained from the Isle of Portland, off the coast of England. Up to 1850 very little progress was made in the manufacture of this cement in England. Since 1855, however, the increase in the production in Europe has been steady, and its superiority has led to a gradually increasing use in such structures as require concrete in mass, as foundations, fortifications, sea-walls, docks, locks, etc. While Portland cement was first manufactured in 1824, and was produced in 1871 by David O. Saylor, at Coplay, Pa., and by Thomas Millen, at South Bend, Ind., it was not until the early Eighties that it was manufactured to any extent in America. From that time on, the production has rapidly increased, reaching the enormous total of nearly 80 000 000 bbl. in 1911. This increase in production has been largely stimulated by the reduction in cost of Portland cement through the perfection of the American

methods, the introduction of reinforced concrete, and the extensive use of cement during the last few years.

In 1850 Joseph Gibbs obtained a British patent for casting solid walls in wooden moulds, and in 1897 C. W. Stevens obtained a patent for making artificial cast stone with concrete. It is not clear, however, that these inventors were the first to use the material in a similar way.

The origin of the idea of increasing the load-carrying capacity of concrete by reinforcing it with metal embedded in it is generally attributed to Joseph Monier, a French gardener, who used a wire frame or skeleton embedded in concrete in the construction of flower pots, tubs, and tanks, in 1867, and for which he obtained the first patent of the kind in the same year. This was not the first use of the material, however, as Lambot constructed a boat of reinforced concrete in 1850, which was exhibited at the Paris Exposition in 1853. He took out an English patent in 1855.

In France, in 1861, François Coignet applied the principles of reinforced concrete in the construction of beams, arches, pipes, etc., and with Monier exhibited some of their work at the Paris Exposition of 1867. Coignet also took out an English patent in 1855. In England, in 1854, W. B. Wilkinson took out a patent for a reinforced concrete floor. In America, Ernest L. Ransome used metal in combination with concrete as early as 1874, and W. E. Ward erected, in 1875, at Port Chester, New York, a house built entirely of reinforced concrete.

Monier, while not the first to apply it, obtained the first patents for reinforced concrete, the German and American rights of which he disposed of to G. A. Wayss and Company in 1880. Wayss and J. Bauschinger, shortly after, began the tests on this material which were published in 1887.

Thaddeus Hyatt, an American engineer, employed David Kirkaldy of London to make the experiments on reinforced concrete which Hyatt published in 1877. The theories of Hyatt were applied in a practical way to building construction in 1877 by H. P. Jackson, of San Francisco.

In America Ransome, between 1874 and 1884, constantly increased his application of metal reinforcement consisting of old wire rope and hoop iron, gradually realizing the necessity for using it with a greater regard for its proper position in the mass, and in 1884 took out the first patent for a deformed bar. Prior to this, reinforced concrete was used but little in the United States. Ransome built his first important structure in 1890, the Leland Stanford, Jr., Museum Building, 312 ft. long, two stories high, with basement, the walls and floors of which were of reinforced concrete. Since 1891, when the first slabs of reinforced concrete were used in America, the development has been rapid.

The introduction of this form of construction proceeded more

slowly in Europe, and between 1891 and 1894 Moeller in Germany, Wünsch and Emperger in Hungary, Melan in Austria, and Hennebique in France, were pioneers in its development. Hennebique built reinforced concrete slabs as early as 1879, but did not patent his system of construction until 1892.

The first published method of computation was by Koenen and Wayss in 1886. Subsequent theories have been advanced by de Mazas, Neuman, Melan, Coignet, de Tedesco, Von Thullie, Ostenfeld, Sanders, Spitzer, Lutken, Ritter, Hatt, Talbot, Turneaure, and others. As early as 1884, Ransome worked out methods of calculation independent of other investigators, and in 1899 Considère published his important series of tests from which he deduced his methods of calculation.

During the last ten years the earlier theories have been somewhat modified as experience has been gained and as the fund of experimental knowledge has accumulated. The trend of the modifications has been toward greater harmony in methods of calculation. Some of the earlier assumptions have been proved fallacious, and generally abandoned. On the other hand, some of the refinements of calculation, though known to be in accordance with facts, have, by general consent, been discarded, as they do not affect the design materially, or are taken into account by a modification of the constants. Among these are the value of the concrete in the tension side of a beam and the lack of a uniform modulus of elasticity in compression of concrete under widely varying stress. The earlier theories did not deal with the diagonal tension under shearing stresses. This has been found to be a most important consideration, and much attention has been paid to it in recent years. In spite of the study which has already been given to it, however, there is still much to learn in this direction. The action of various forms of reinforcement in columns has received much consideration, and there is still a wide difference of opinion as to the efficacy of some forms of column reinforcement. Many experiments have been made in this branch of the subject, and practice appears to be gradually converging toward greater uniformity.

In the preparation of this historical sketch, the Committee has endeavored to verify the facts, and has received the co-operation of H. Kempton Dyson, Secretary of the Concrete Institute of England, Alfred Huser, President, Deutscher Beton-Verein, C. von Bach, Otto Leube, of Germany, Karl Naehr, of Austria, Joseph Schustler, of Hungary, and H. I. Hannover, of Denmark, to whom the Committee wishes to acknowledge its appreciation and thanks.

3.—Authorities on Which Recommendations are Based.

It has been suggested that a report such as this should include all the data on which conclusions are based. The impracticability of this may not be realized by those who are not familiar with the enormous

quantity of matter involved. There are, however, reasons other than the magnitude of the task which tend to show that full publication is not advisable. One of these is that most of the experimental results have already appeared in print and are now available, and a reprint of them would be of no great advantage to any one. Where originally printed they are frequently accompanied with comments and deductions by their authors, which are of great value as such but could scarcely be copied by the Committee. Another reason against publication is that, in the large part of the experimental work consulted, it has been found that certain vitally important information, either with regard to the materials, the way in which they are manipulated, or as to the precise results reached, is lacking. The omission of measurements of deformations, of course, frequently renders results of little value. While such tests may have some use on account of particular facts developed, a large part may be useless, and consequently unsuitable for publication. The difficulty of separating the valuable from the valueless would be almost insurmountable.

It may not be improper, however, to append the following list of authors and references, as comprising a considerable part of the most important published material on the subject under consideration:

C. v. Bach.—"Compressive Tests": *Deutsche Bauzeitung,* 1905, 68 (No. 17). *Mitteilungen über Forschungsarbeiten,* Nos. 22, 29, 39, 45-47, 72-74.

E. Candlot.—"Cements and Mortars": *"Ciments et Chaux Hydrauliques,"* 1898, pp. 446, 447.

Howard A. Carson.—"Plain and Reinforced Concrete Beams": Boston Transit Commission, 10th Annual Report, 1904, Appendix G.

A. Considère.—"Reinforced Beams and Columns": *Comptes Rendus de l'Academie des Sciences,* CXXVII, p. 992; CXXIX, p. 467; CXXXV, Sept. 8, 1902; CXL, June 30, 1905.

F. v. Emperger.—*"Forschungsarbeiten auf dem Gebiete des Eisenbetons,"* No. 8.

R. Feret.—*"Sur la Compacité des Mortiers Hydrauliques": Annales des Ponts et Chaussees,* 1892, II. "Composition, Various Tests of Reinforcing": *Etude Experimentale du Ciment Armé,* 1906.

William B. Fuller and Sanford E. Thompson.—"Composition and Density": *Transactions,* American Society of Civil Engineers, Vol. LIX, 1907, p. 67.

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In addition to the authorities above quoted, the Committee desires to acknowledge with thanks the discussions of its progress reports, which have appeared from time to time, and to say that all the points brought out therein have been carefully weighed.

4.—Character of Report Presented.

At the time of the appointment of the Committee, in 1904, there existed a great diversity of opinion in America as to methods of design, safe allowable working stresses, and methods of proportioning, handling, etc. A great deal of experimental work had been done, but there was need of a clearing house through which results could be compared and divergent views harmonized. During the interval between the appointment of the Committee and the preparation of its first Progress Report rapid advance was made in the art of concrete construction aided by the results of the investigations and the experience acquired by constructors. This report, which was submitted in 1909, attempted to embody recommendations for safe methods of construction and design in accordance with the best practice of the day. It would have been impossible for such a report to meet with the approval of all, and the Committee is well satisfied that its most vital recommendations have met with quite general acceptance by the engineers of the country.

Since the appearance of the first Progress Report, many experiments have been conducted by some of the technical institutions and by private and corporate interests, and through these and through longer experience in construction by its members and others, the Committee is now able to make some perfecting modifications of its former report and to add some entirely new material. The time, therefore, seems opportune for presenting this second report, bringing the work up to date.

The Committee would point out that while the report deals with every kind of stress to which concrete is subjected, and includes all ordinary conditions of proportioning and handling, it does not go into all types of construction or all the applications to which concrete and reinforced concrete may be put.

It is not to be assumed that the Committee in presenting this report wishes to imply that further improvements are not possible. A careful reading will disclose many points on which the present deductions are regarded as only tentative; but it has been the aim of the Committee to cover as fully as possible recommendations based on the present state of the art.

This report is what the word implies, and nothing more; it is not a "specification", but may be used as a basis for specifications.

The use of concrete and reinforced concrete involves the exercise of good judgment to a greater degree than for any other building material.

Rules cannot produce or supersede judgment; on the contrary, judgment should control the interpretation and application of rules.

II. Adaptability of Concrete and Reinforced Concrete.

The adaptability of concrete and reinforced concrete for engineering structures, or parts thereof, is now so well established that they may be considered the recognized materials of construction. They have proved satisfactory materials, when properly used, for those purposes for which their qualities make them particularly suitable.

1.—Uses.

Concrete is a material of very low tensile strength, and capable of sustaining but very small tensile deformations without rupture; its value as a structural material depends chiefly on its durability, its fire-resistive qualities, its strength in compression, its relatively low cost, and its adaptability to placing, especially where space is cramped or limited. Its strength increases generally with age.

Concrete is well adapted for structures in which the principal stresses are compressive, such as foundations, dams, retaining and other walls, tunnels, piers, abutments, short columns, and, in many cases, arches. In the design of massive concrete, the tensile strength of the material in resisting principal stresses must generally be neglected.

By the use of metal reinforcement to resist the principal tensile stresses, concrete becomes available for general use in a great variety of structures and structural forms. This combination of concrete and metal is particularly advantageous in the beam, where both compression and tension exist; it is also advantageous in the column, where

the main stresses are compressive, but where cross-bending may exist. In structures resisting lateral forces, it possesses advantages over plain concrete in that it may be designed so as to utilize more fully the strength rather than the weight of the material. Metal reinforcement may also be of value in distributing cracks due to shrinkage and temperature changes.

2.—Precautions.

Failures of reinforced concrete structures are usually due to any one or a combination of the following causes: defective design, poor material, faulty execution, and premature removal of forms.

The defects in a design may be many and various. The computations and assumptions on which they were based may be faulty and contrary to the established principles of statics and mechanics; the unit stresses used may be excessive, or the details of the design defective.

Articulated concrete structures designed in imitation of steel trusses, may be mentioned as illustrating a questionable use of reinforced concrete, and such structures are not recommended.

Poor material is sometimes used for the concrete, as well as for the reinforcement. The use of poor aggregates, especially sand, which have not been tested, is a common source of defect. Inferior concrete is frequently due also to lack of experience on the part of the contractor and his superintendents, or to the absence of proper supervision.

An unsuitable quality of metal for reinforcement is sometimes prescribed in specifications, for the purpose of reducing the cost. For steel structures, a high grade of material is specified, but the steel used for reinforcing concrete is sometimes made of unsuitable, brittle material.

Faulty execution, careless workmanship, and too early removal of forms may generally be attributed to unintelligent or insufficient supervision.

3.—Responsibility and Supervision.

The design of reinforced concrete structures should receive at least the same careful consideration as those of steel, and only engineers with sufficient experience and good judgment should be intrusted with such work.

The computations should include all minor details, which are sometimes of the utmost importance. The design should show clearly the size and position of the reinforcement, and should provide for proper connections between the component parts, so that they cannot be displaced. As the connections between reinforced concrete members are frequently a source of weakness, the design should include a detailed

study of such connections, accompanied by computations to prove their strength.

While other engineering structures on the safety of which human lives depend are generally designed by engineers employed by the owner, and the contracts let on the engineer's design and specifications, in accordance with legitimate practice, reinforced concrete structures frequently are designed by contractors or by engineers commercially interested, and the contract let for a lump sum.

The construction of buildings in large cities is regulated by ordinances or building laws, and the work is inspected by municipal authorities. For reinforced concrete work, however, the limited supervision which municipal inspectors are able to give is not sufficient. Therefore, means for more adequate supervision and inspection should be provided.

The execution of the work should not be separated from the design, as intelligent supervision and successful execution can be expected only when both functions are combined. The engineer who prepares the design and specifications, therefore, should have the supervision of the execution of the work.

The Committee recommends the following rules for structures of reinforced concrete for the purpose of fixing the responsibility and providing for adequate supervision during construction:

(*a*) Before work is commenced, complete plans shall be prepared, accompanied by specifications, stress computations, and descriptions showing the general arrangement and all details. The plans shall show the size, length, dimensions for points of bending, and exact position of all reinforcement, including stirrups, ties, hooping, and splicing. The computations shall give the loads assumed separately, such as dead and live loads, wind, and impact, if any, and the resulting stresses.

(*b*) The specifications shall state the qualities of the materials to be used for making the concrete, and the manner in which they are to be proportioned.

(*c*) The strength which the concrete is expected to attain after a definite period shall be stated in the specifications.

(*d*) The drawings and specifications shall be signed by the engineer and the contractor.

(*e*) Plans and specifications for all public structures should be approved by a legally authorized State or City official, and copies of such plans and specifications placed on file in his office.

(*f*) The approval of plans and specifications by other authorities shall not relieve the engineer or the contractor of responsibility.

(*g*) Inspection during construction shall be made by competent inspectors employed by and under the supervision of the engineer, and shall cover the following:

1. The materials.
2. The correct construction and erection of the forms and the supports.
3. The sizes, shapes, and arrangement of the reinforcement.
4. The proportioning, mixing, and placing of the concrete.
5. The strength of the concrete, by tests of standard test pieces made on the work.
6. Whether the concrete is sufficiently hardened before the forms and supports are removed.
7. Prevention of injury to any part of the structure by and after the removal of the forms.
8. Comparison of dimensions of all parts of the finished structure with the plans.

(*h*) Load tests on portions of the finished structure shall be made where there is reasonable suspicion that the work has not been properly performed, or that, through influences of some kind, the strength has been impaired. Loading shall be carried to such a point that one and three-quarters times the calculated working stresses in critical parts are reached, and such loads shall cause no injurious permanent deformations. Load tests shall not be made until after 60 days of hardening.

4.—Destructive Agencies.

(*a*) *Corrosion of Metal Reinforcement.*—Tests and experience indicate that steel sufficiently embedded in good concrete is well protected against corrosion, no matter whether located above or below water level. It is recommended that such protection be not less than 1 in. in thickness. If the concrete is porous, so as to be readily permeable by water, as when the concrete is laid with a very dry consistency, the metal may corrode on account of the presence of moisture and air.

(*b*) *Electrolysis.*—The most recent experimental data available on this subject seem to show that while reinforced concrete structures may, under certain conditions, be injured by the flow of electric current in either direction between the reinforcing material and the concrete, such injury is generally to be expected only where voltages are considerably higher than those which usually occur in concrete structures in practice. If the iron be positive, trouble may manifest itself by corrosion of the iron accompanied by cracking of the concrete, and, if the iron be negative, there may be a softening of the concrete near the surface of the iron, resulting in a destruction of the bond. The former, or anode effect, decreases much more rapidly than the voltage, and almost if not quite disappears at voltages that are most likely to be encountered in practice. The cathode effect, on the other hand, takes place even on very low voltages, and is therefore more important from a practical standpoint than that of the anode.

Structures containing salt or calcium chloride, even in very small

quantities, are very much more susceptible to the effects of electric currents than normal concrete, both the anode and cathode effects progressing much more rapidly in the presence of chlorine.

There is great weight of evidence to show that normal reinforced concrete structures free from salt are in very little danger under most practical conditions, while non-reinforced concrete structures are practically immune from electrolysis troubles.

The results of experiments now in progress may yield more conclusive information on this subject.

(*c*) *Sea Water.*—The data available concerning the effect of sea water on concrete or reinforced concrete are limited and inconclusive. Sea walls out of the range of frost action have been standing for many years without apparent injury. In many harbors where the water is brackish, through rivers discharging into them, serious disintegration has taken place. This has occurred chiefly between low and high tide levels, and is due, evidently, in part to frost. Chemical action also appears to be indicated by the softening of the mortar. To effect the best resistance to sea water, the concrete must be proportioned, mixed, and placed so as to prevent the penetration of sea water into the mass or through the joints. The cement should be of such chemical composition as will best resist the action of sea water; the aggregates should be carefully selected, graded, and proportioned with the cement so as to secure the maximum possible density; the concrete should be thoroughly mixed; the joints between old and new work should be made water-tight; and the concrete should be kept from exposure to sea water until it is thoroughly hard and impervious.

(*d*) *Acids.*—Concrete of first-class quality, thoroughly hardened, is affected appreciably only by strong acids which seriously injure other materials. A substance like manure is injurious to green concrete, but after the concrete has hardened thoroughly it resists the action of such acid satisfactorily.

(*e*) *Oils.*—When concrete is properly made and the surface is carefully finished and hardened, it resists the action of such mineral oils as petroleum and ordinary engine oils. Oils which contain fatty acids produce injurious effects, forming compounds with the lime which result in a disintegration of the concrete in contact with them.

(*f*) *Alkalies.*—The action of alkalies on concrete is problematical. In the reclamation of arid land, where the soil is heavily charged with alkaline salts, it has been found that concrete, stone, brick, iron, and other materials are injured under certain conditions. It would seem that at the level of the ground-water, in an extremely dry atmosphere, such structures are disintegrated, through the rapid crystallization of the alkaline salts, resulting from the alternate wetting and drying of the surface. Such destructive action can be prevented by the use of a protective coating, and is minimized by securing a dense concrete.

III. Materials.

A knowledge of the properties of the materials entering into concrete and reinforced concrete is the first essential. The importance of the quality of the materials used cannot be overestimated, and not only the cement but also the aggregates should be subject to such definite requirements and tests as will insure concrete of the desired quality.

1.—Cement.

There are available for construction purposes: Portland, Natural, and Puzzolan or Slag cements. Only Portland cement is suitable for reinforced concrete.

(*a*) *Portland Cement.*—This is the finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials. It has a definite chemical composition varying within comparatively narrow limits.

Portland cement should be used in reinforced concrete construction and any construction that will be subject to shocks or vibrations or stresses other than direct compression.

(*b*) *Natural Cement.*—This is the finely pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to drive off the carbonic acid gas. Although the limestone must have a certain composition, this composition may vary within much wider limits than in the case of Portland cement. Natural cement does not develop its strength as quickly, nor is it as uniform in composition, as Portland cement.

Natural cement may be used in massive masonry where weight rather than strength is the essential feature.

Where economy is the governing factor, a comparison may be made between the use of natural cement and a leaner mixture of Portland cement that will develop the same strength.

(*c*) *Puzzolan or Slag Cement.*—This is the finely pulverized product resulting from grinding a mechanical mixture of granulated basic blast furnace slag and hydrated lime.

Puzzolan cement is not nearly as strong, uniform, or reliable as Portland or natural cement, is not used extensively, and never in important work; it should be used only for foundation work underground where it is not exposed to air or running water.

(*d*) *Specifications.*—The cement should meet the requirements of the Standard Methods of Testing and Specifications for Cement (see Appendix, p. 158), or as may be hereafter amended, the result of the joint labors of Special Committees of the American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering Association, and others.

2.—Aggregates.

Extreme care should be exercised in selecting the aggregates for mortar and concrete, and careful tests made of the materials for the purpose of determining their qualities and the grading necessary to secure maximum density* or a minimum percentage of voids.

(*a*) *Fine Aggregate.*—This should consist of sand, crushed stone, or gravel screenings, graded from fine to coarse, and passing when dry a screen having holes ¼ in. in diameter; it is preferable that it be of silicious material, and should be clean, coarse, free from dust, soft particles, vegetable loam, or other deleterious matter; and not more than 6% should pass a sieve having 100 meshes per lin. in. Fine aggregates should always be tested.

Fine aggregate should be of such quality that mortar composed of one part Portland cement and three parts fine aggregate by weight, when made into briquettes, will show a tensile strength at least equal to the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand.† If the aggregate be of poorer quality, the proportion of cement in the mortar should be increased to secure the desired strength.

If the strength developed by the aggregate in the 1:3 mortar is less than 70% of the strength of the Ottawa sand mortar, the material should be rejected. To avoid the removal of any coating on the grains, which may affect the strength, bank sands should not be dried before being made into mortar, but should contain natural moisture. The percentage of moisture may be determined on a separate sample for correcting weight. From 10 to 40% more water may be required in mixing bank or artificial sands than for standard Ottawa sand to produce the same consistency.

(*b*) *Coarse Aggregate.*—This should consist of crushed stone or gravel which is retained on a screen having holes ¼ in. in diameter, and graded from the smallest to the largest particles; it should be clean, hard, durable, and free from all deleterious matter. Aggregates containing dust, and soft, flat, or elongated particles, should be excluded from important structures.

The maximum size of the coarse aggregate is governed by the character of the construction.

For reinforced concrete and for small masses of unreinforced concrete, the aggregate must be small enough to produce with the mortar a homogeneous concrete of viscous consistency which will pass readily

*A convenient coefficient of density is the ratio of the sum of the volumes of materials contained in a unit volume to the total unit volume.

†A natural sand obtained at Ottawa, Ill., passing a screen having 20 meshes and retained on a screen having 30 meshes per lin. in.; prepared and furnished by the Ottawa Silica Company, for 2 cents per lb., f. o. b. cars, Ottawa, Ill., under the direction of the Special Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

between and easily surround the reinforcement and fill all parts of the forms.

For concrete in large masses, the size of the coarse aggregate may be increased, as a large aggregate produces a stronger concrete than a fine one, although it should be noted that the danger of separation from the mortar becomes greater as the size of the coarse aggregate increases.

Cinder concrete should not be used for reinforced concrete structures. It may be allowable in mass for very light loads or for fire protection purposes. The cinders used should be composed of hard, clean, vitreous clinker, free from sulphides, unburned coal, or ashes.

3.—Water.

The water used in mixing concrete should be free from oil, acid, alkalies, or organic matter.

4.—Metal Reinforcement.

The Committee recommends, as a suitable material for reinforcement, steel filling the requirements for structural steel reinforcement of the specifications adopted by the American Railway Engineering Association (Appendix, p. 161).

Where little bending or shaping is required, and also for reinforcement for shrinkage and temperature stresses, material filling the requirements of the specifications adopted by the American Railway Engineering Association for high-carbon steel (Appendix, p. 161) may be used, adopting the same unit stress as hereinafter recommended for structural grade material.

For the reinforcement of slabs, small beams, or minor details, or for reinforcement for shrinkage and temperature stresses, wire drawn from bars of the grade of rivet steel may be used, with the unit stresses hereinafter recommended.

The reinforcement should be free from excessive rust, scale, or coatings of any character which would tend to reduce or destroy the bond.

IV. Preparing and Placing Mortar and Concrete.

1.—Proportions.

The materials to be used in concrete should be carefully selected, of uniform quality, and proportioned with a view to securing as nearly as possible a maximum density.

(*a*) *Unit of Measure.*—The unit of measure should be the cubic foot. A bag of cement, containing 94 lb. net, should be considered the equivalent of 1 cu. ft.

The measurement of the fine and coarse aggregates should be by loose volume.

(*b*) *Relation of Fine and Coarse Aggregates.*—The fine and coarse aggregate should be used in such relative proportions as will insure maximum density. In unimportant work it is sufficient to do this by individual judgment, using correspondingly higher proportions of cement; for important work these proportions should be carefully determined by density experiments, and the sizing of the fine and coarse aggregates should be uniformly maintained or the proportions changed to meet the varying sizes.

(*c*) *Relation of Cement and Aggregates.*—For reinforced concrete construction, one part of cement to a total of six parts of fine and coarse aggregates measured separately should generally be used. For columns, richer mixtures are generally preferable, and in massive masonry or rubble concrete, a mixture of 1:9 or even 1:12 may be used.

These proportions should be determined by the strength or the wearing qualities required in the construction at the critical period of its use. Experienced judgment based on individual observation and tests of similar conditions in similar localities is an excellent guide as to the proper proportions for any particular case.

For all important construction, advance tests should be made of concrete, of the materials, proportions, and consistency to be used in the work. These tests should be made under laboratory conditions to obtain uniformity in mixing, proportioning, and storage, and in case the results do not conform to the requirements of the work, aggregates of a better quality should be chosen, or richer proportions used to obtain the desired results.

2.—Mixing.

The ingredients of concrete should be thoroughly mixed, and the mixing should continue until the cement is uniformly distributed and the mass is uniform in color and homogeneous. As the maximum density and greatest strength of a given mixture depend largely on thorough and complete mixing, it is essential that the work of mixing should receive special attention and care.

Inasmuch as it is difficult to determine, by visual inspection, whether the concrete is uniformly mixed, especially where limestone or aggregates having the color of cement are used, it is essential that the mixing should occupy a definite period of time. The minimum time will depend on whether the mixing is done by machine or hand.

(*a*) *Measuring Ingredients.*—Methods of measurement of the proportions of the various ingredients should be used which will secure separate and uniform measurements of cement, fine aggregate, coarse aggregate, and water, at all times.

(*b*) *Machine Mixing.*—When the conditions will permit, a machine mixer of a type which insures the uniform proportioning of the

materials throughout the mass should be used, as a more uniform consistency can be thus obtained. The mixing should continue for a minimum time of at least 1 min. after all the ingredients are assembled in the mixer.

(*c*) *Hand Mixing.*—When it is necessary to mix by hand, the mixing should be on a water-tight platform, and especial precautions should be taken to turn all the ingredients together at least six times and until they are homogeneous in appearance and color.

(*d*) *Consistency.*—The materials should be mixed wet enough to produce a concrete of such a consistency as will flow into the forms and about the metal reinforcement when used, and which, at the same time, can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar.

(*e*) *Retempering.*—Mortar or concrete should not be remixed with water after it has partly set.

3.—Placing Concrete.

(*a*) *Methods.*—Concrete, after the completion of the mixing, should be handled rapidly, and in as small masses as is practicable, from the place of mixing to the place of final deposit, and under no circumstances should concrete be used that has partly set. A slow-setting cement should be used when a long time is likely to occur between mixing and placing.

Concrete should be deposited in such a manner as will permit the most thorough compacting, such as can be obtained by working with a straight shovel or slicing tool kept moving up and down until all the ingredients have settled in their proper places by gravity, and the surplus water has been forced to the surface. Special care should be exercised to prevent the formation of laitance, which hardens very slowly and forms a poor surface on which to deposit fresh concrete. All laitance should be removed.

Before depositing concrete, the reinforcement should be carefully placed in accordance with the plans, and adequate means provided to hold it in its proper position until the concrete has been deposited and compacted; care should be taken to see that the forms are substantial and thoroughly wetted (except in freezing weather) or oiled, and that the space to be occupied by the concrete is free from débris. When the placing of concrete is suspended, all necessary grooves for joining future work should be made before the concrete has had time to set.

When work is resumed, concrete previously placed should be roughened, thoroughly cleansed of foreign material and laitance, thoroughly wetted, and then slushed with a mortar consisting of one part Portland cement and not more than two parts fine aggregate.

The faces of concrete exposed to premature drying should be kept wet for a period of at least 7 days.

(*b*) *Freezing Weather.*—Concrete should not be mixed or deposited at a freezing temperature, unless special precautions are taken to avoid the use of materials covered with ice crystals or containing frost, and to provide means to prevent the concrete from freezing after being placed in position and until it has thoroughly hardened.

As the coarse aggregate forms the greater portion of the concrete, it is particularly important that this material be heated to well above the freezing point.

(*c*) *Rubble Concrete.*—Where the concrete is to be deposited in massive work, its value may be improved and its cost materially reduced by the use of clean stones thoroughly embedded in the concrete as near together as is possible and still entirely surrounded by concrete.

(*d*) *Under Water.*—In placing concrete under water, it is essential to maintain still water at the place of deposit. The use of tremies, properly designed and operated, is a satisfactory method of placing concrete through water. The concrete should be mixed very wet (more so than is ordinarily permissible) so that it will flow readily through the tremie and into the place with practically a level surface.

The coarse aggregate should be smaller than ordinarily used, and never more than 1 in. in diameter. The use of gravel facilitates mixing and assists the flow of concrete through the tremie. The mouth of the tremie should be buried in the concrete so far that it is at all times entirely sealed and the surrounding water prevented from forcing itself into the tremie; the concrete will then discharge without coming in contact with the water. The tremie should be suspended so that it can be lowered quickly when it is necessary either to choke off or prevent too rapid flow; the lateral flow should preferably be not more than 15 ft.

The flow should be continuous, in order to produce a monolithic mass and prevent the formation of laitance in the interior.

In large structures it may be necessary to divide the mass of concrete into several small compartments or units, filling one at a time. With proper care, it is possible in this manner to obtain as good results under water as in the air.

V. Forms.

Forms should be substantial and unyielding, so that the concrete shall conform to the designed dimensions and contours; and they should be tight in order to prevent the leakage of mortar.

The time for removal of forms is one of the most important steps in the erection of a structure of concrete or reinforced concrete. Care should be taken to inspect the concrete and ascertain its hardness before removing the forms.

So many conditions affect the hardening of concrete that the proper time for the removal of the forms should be decided by some competent

and responsible person, especially where the atmospheric conditions are unfavorable.

It may be stated in a general way that forms should remain in place longer for reinforced concrete than for plain or massive concrete, and that forms for floors, beams, and similar horizontal structures should remain in place much longer than for vertical walls.

When the concrete gives a distinctive ring under the blow of a hammer, it is generally an indication that it has hardened sufficiently to permit the removal of the forms with safety. If, however, the temperature is such that there is any possibility that the concrete is frozen, this test is not a safe reliance, as frozen concrete may appear to be very hard.

VI. Details of Construction.

1.—Joints.

(*a*) *Concrete.*—For concrete construction it is desirable to cast the entire structure at one operation, but as this is not always possible, especially in large structures, it is necessary to stop the work at some convenient point. This point should be selected so that the resulting joint may have the least possible effect on the strength of the structure. It is therefore recommended that the joints in columns be made flush with the lower side of the girders; that the joints in girders be at a point midway between supports, but should a beam intersect a girder at this point, the joint should be offset a distance equal to twice the width of the beam; that the joints in the members of a floor system should in general be made at or near the center of the span.

Joints in columns should be perpendicular to the axis of the column, and in girders, beams, and floor slabs perpendicular to the plane of their surfaces.

Girders should never be constructed over freshly formed columns without permitting a period of at least 2 hours to elapse, thus providing for settlement or shrinkage in the columns.

Shrinkage and contraction joints may be necessary in concrete subject to great fluctuations in temperature. The frequency of these joints will depend, first, on the range of temperature to which the concrete will be subjected, and second, on the quantity and position of the reinforcement. These joints should be determined, and provided for in the design. In massive work, such as retaining walls, abutments, etc., built without reinforcement, contraction joints should be provided at intervals of from 25 to 50 ft. and with reinforcement from 50 to 80 ft. (the smaller the height and thickness, the closer the spacing) throughout the length of the structure. To provide against the structure being thrown out of line by unequal settlement, each section of the wall should be tongued and grooved into the adjoining section. A groove should be formed in the surface of the concrete at vertical joints in walls or abutments.

Shrinkage and contraction joints should be lubricated by either an application of petroleum residuum oil or a similar material, so as to permit a free movement at the joint when the concrete expands or contracts.

The insertion of a sheet of copper or zinc, or even tarred paper, will be found advantageous in securing expansion and contraction at the joint.

(*b*) *Reinforcement.*—Wherever it is necessary to splice tension reinforcement, the length of lap should be determined on the basis of the safe bond stress, the stress in the bar, and the shearing resistance of the concrete at the point of splice; or a connection should be made between the bars of sufficient strength to carry the stress. Splices at points of maximum stress should be avoided. In columns, bars more than $\frac{3}{4}$ in. in diameter, not subject to tension, should be properly squared and butted in a suitable sleeve; smaller bars may be treated as indicated for tension reinforcement, or the stress may be cared for by embedment in large masses of concrete. At foundations, bearing plates should be provided for supporting the bars, or the bars may be carried into the footing a sufficient distance to transmit the stress of the steel to the concrete by means of the bearing and bond resistance; in no case shall the ends of the bars be permitted merely to rest on concrete.

2.—Shrinkage and Temperature Changes.

Shrinkage of concrete, due to hardening and contraction from temperature changes, causes cracks the size of which depends on the extent of the mass. The resulting stresses are important in monolithic construction, and should be considered carefully by the designer; they cannot be counteracted successfully, but the effects can be minimized.

Large cracks, produced by quick hardening or wide ranges of temperature, can be broken up to some extent into small cracks by placing reinforcement in the concrete; in long continuous lengths of concrete, it is better to provide shrinkage joints at points in the structure where they will do little or no harm. Reinforcement is of assistance, and permits longer distances between shrinkage joints than when no reinforcement is used.

Small masses or thin bodies of concrete should not be joined to larger or thicker masses without providing for shrinkage at such points. Fillets similar to those used in metal castings, but of larger dimensions, for gradually reducing from the thicker to the thinner body, are of advantage.

Shrinkage cracks are likely to occur at points where fresh concrete is joined to that which is set, and hence, in placing the concrete, construction joints should be made on horizontal and vertical lines, and, if possible, at points where joints would naturally occur in dimension-stone masonry.

3.—Fire-Proofing.

The actual fire tests of concrete and reinforced concrete have been limited, but experience, together with the results of tests thus far made, indicates that concrete, on account of its low rate of heat conductivity and the fact that it is incombustible, may be used safely for fire-proofing purposes.

The dehydration of concrete probably begins at about 500° Fahr., and is completed at about 900° Fahr., but experience indicates that the volatilization of the water absorbs heat from the surrounding mass, which, together with the resistance of the air cells, tends to increase the heat resistance of the concrete, so that the process of dehydration is very much retarded. The concrete that is actually affected by fire remains in position and affords protection to the concrete beneath it.

The thickness of the protective coating required depends on the probable duration of a fire which is likely to occur in the structure, and should be based on the rate of heat conductivity. The question of the conductivity of concrete is one which requires further study and investigation before a definite rate for different classes of concrete can be fully established. However, for ordinary conditions, it is recommended that the metal in girders and columns be protected by a minimum of 2 in. of concrete; that the metal in beams be protected by a minimum of 1½ in. of concrete; and that the metal in floor slabs be protected by a minimum of 1 in. of concrete.

It is recommended that, in monolithic concrete columns, the concrete to a depth of 1½ in. be considered as protective covering, and not included in the effective section.

It is recommended that the corners of columns, girders, and beams be beveled or rounded, as a sharp corner is more seriously affected by fire than a round one.

4.—Water-Proofing.

Many expedients have been used to render concrete impervious to water under normal conditions, and also under pressure conditions that exist in reservoirs, dams, and conduits of various kinds. Experience shows, however, that where mortar or concrete is proportioned to obtain the greatest practicable density and is mixed to a rather wet consistency, the resulting mortar or concrete is impervious under moderate pressure.

A concrete of dry consistency is more or less pervious to water, and compounds of various kinds have been mixed with the concrete, or applied as a wash to the surface for the purpose of making it water-tight. Many of these compounds are of but temporary value, and in time lose their power of imparting impermeability to the concrete.

In the case of subways, long retaining walls, and reservoirs, provided the concrete itself is impervious, cracks may be so reduced by

horizontal and vertical reinforcement properly proportioned and located, that they are too minute to permit leakage, or are soon closed by infiltration of silt.

Coal-tar preparations, applied either as a mastic or as a coating on felt or cloth fabric, are used for water-proofing, and should be proof against injury by liquids or gases.

For retaining and similar walls in direct contact with the earth, the application of one or two coatings of hot coal-tar pitch to the thoroughly dried surface of concrete is an efficient method of preventing the penetration of moisture from the earth.

5.—Surface Finish.

Concrete is a material of an individual type, and should not be used in imitation of other structural materials. One of the important problems connected with its use is the character of the finish of exposed surfaces. The finish of the surface should be determined before the concrete is placed, and the work should be conducted so as to make possible the finish desired. For many forms of construction the natural surface of the concrete is unobjectionable, but frequently the marks of the boards and the flat dead surface are displeasing, making some special treatment desirable. A treatment of the surface, either by scrubbing it while green or by tooling it after it is hard, which removes the film of mortar and brings the aggregates of the concrete into relief is frequently used to remove the form markings, break the monotonous appearance of the surface, and make it more pleasing. The plastering of surfaces, as ordinarily applied, should be avoided, for, even if carefully done, it is likely to peel off under the action of frost or temperature changes.

VII. Design.

1.—Massive Concrete.

In the design of massive or plain concrete, no account should be taken of the tensile strength of the material, and sections should usually be proportioned so as to avoid tensile stresses, except in slight amounts to resist indirect stresses. This will generally be accomplished, in the case of rectangular shapes, if the line of pressure is kept within the middle third of the section, but, in very large structures, such as high masonry dams, a more exact analysis may be required. Structures of massive concrete are able to resist unbalanced lateral forces by reason of their weight, hence the element of weight rather than strength often determines the design. A relatively cheap and weak concrete, therefore, will often be suitable for massive concrete structures.

It is desirable, generally, to provide joints at intervals, to localize the effect of contraction.

Massive concrete is suitable for dams, retaining walls, and piers and short columns in which the ratio of length to least width is relatively small. Under ordinary conditions, this ratio should not exceed six. It is also suitable for arches of moderate span, where the conditions as to foundations are favorable.

2.—Reinforced Concrete.

By the use of metal reinforcement to resist the principal tensile stresses, concrete becomes available for general use in a great variety of structures and structural forms. This combination of concrete and metal is particularly advantageous in the beam, where both compression and tension exist; it is also advantageous in the column, where the main stresses are compressive, but where cross-bending may exist. The theory of design, therefore, will relate mainly to the analysis of beams and columns.

3.—General Assumptions.

(*a*) *Loads.*—The loads or forces to be resisted consist of:

1. *The Dead Load.*—This includes the weight of the structure and fixed loads and forces.
2. *The Live Load.*—This consists of the loads and forces which are variable. The dynamic effect of the live load will often require consideration. Any allowance for the dynamic effect is preferably taken into account by adding the desired amount to the live load or to the live-load stresses. The working stresses hereinafter recommended are intended to apply to the equivalent static stresses thus determined.

   In the case of high buildings, the live load on columns may be reduced in accordance with the usual practice.

(*b*) *Lengths of Beams and Columns.*—The span length for beams and slabs shall be taken as the distance from center to center of supports, but need not be taken to exceed the clear span plus the depth of beam or slab. Brackets shall not be considered as reducing the clear span in the sense here intended.

The length of columns shall be taken as the maximum unsupported length.

(*c*) *Internal Stresses.*—As a basis for calculations relating to the strength of structures, the following assumptions are recommended:

1. Calculations will be made with reference to working stresses and safe loads, rather than with reference to ultimate strength and ultimate loads.
2. A plane section before bending remains plane after bending.
3. The modulus of elasticity of concrete in compression, within the usual limits of working stresses, is constant. The distribution of compressive stresses in beams, therefore, is rectilinear.

4. In calculating the moment of resistance of beams, the tensile stresses in the concrete are neglected.
5. Perfect adhesion is assumed between concrete and reinforcement. Under compressive stresses, the two materials, therefore, are stressed in proportion to their moduli of elasticity.
6. The ratio of the modulus of elasticity of steel to the modulus of elasticity of concrete is taken at 15, except as modified in Chapter VIII, Section 8.
7. Initial stress in the reinforcement, due to contraction or expansion in the concrete, is neglected.

It is recognized that some of the assumptions given herein are not entirely borne out by experimental data. They are given in the interest of simplicity and uniformity, and variations from exact conditions are taken into account in the selection of formulas and working stresses.

The deflection of beams is affected by the tensile strength developed throughout the length of the beam. For calculations of deflections, a value of 8 for the ratio of the moduli will give results corresponding approximately with the actual conditions.

4.—T-Beams.

In beam and slab construction, an effective bond should be provided at the junction of the beam and slab. When the principal slab reinforcement is parallel to the beam, transverse reinforcement should be used, extending over the beam and well into the slab.

Where adequate bond and shearing resistance between slab and web of beam is provided, the slab may be considered as an integral part of the beam, but its effective width shall be determined by the following rules:

(*a*) It shall not exceed one-fourth of the span length of the beam;
(*b*) Its overhanging width on either side of the web, shall not exceed four times the thickness of the slab.

In the design of T-beams acting as continuous beams, due consideration should be given to the compressive stresses at the support.

Beams in which the tee form is used only for the purpose of providing additional compression area of concrete should preferably have a width of flange not more than three times the width of the stem and a thickness of flange not less than one-third of the depth of the beam. Both in this form and in the beam and slab form, the web stresses and the limitations in placing and spacing the longitudinal reinforcement will probably be controlling factors in design.

5.—Floor Slabs.

Floor slabs should be designed and reinforced as continuous over the supports. If the length of the slab exceeds one and five-tenth times its

width, the entire load should be carried by transverse reinforcement. Square slabs may well be reinforced in both directions.*

The continuous flat slab with multiple-way reinforcement is a type of construction used quite extensively, and has recognized advantages for special conditions, as in the case of warehouses with large, open, floor space. At present, a considerable difference of opinion exists among engineers as to the formulas and constants which should be used, but experience and tests are accumulating data which it is hoped will in the near future permit the formulation of the principles of design for this form of construction.

The loads carried to beams by slabs which are reinforced in two directions will not be uniformly distributed to the supporting beam, and its distribution will depend on the relative stiffness of the slab and the supporting beam. The distribution under ordinary conditions of construction may be expected to be that in which the load on the beam varies in accordance with the ordinates of a parabola having its vertex at the middle of the span. For any given design, the probable distribution should be ascertained, and the moments in the beam calculated accordingly.

6.—Continuous Beams and Slabs.

When the beam or slab is continuous over its supports, reinforcement should be fully provided at points of negative moment, and the stresses in concrete recommended in Chapter VIII, Section 4, should not be exceeded. In computing the positive and negative moments in beams and slabs continuous over several supports, due to uniformly distributed loads, the following rules are recommended:

(*a*) That for floor slabs, the bending moments at center and at support be taken at $\frac{wl^2}{12}$ for both dead and live loads, where w represents the load per linear foot and l the span length.

* The exact distribution of load on square and rectangular slabs, supported on four sides and reinforced in both directions, cannot readily be determined. The following method of calculation is recognized as faulty, but it is offered as a tentative method which will give results on the safe side. The distribution of load is first to be determined by the formula:

$$r = \frac{l^4}{l^4 + b^4}$$

in which r = proportion of load carried by the transverse reinforcement, l = length, and b = breadth of slab. For various ratios of $\frac{l}{b}$ the values of r are as follows:

$\frac{l}{b}$	r
1	0.50
1.1	0.59
1.2	0.67
1.3	0.75
1.4	0.80
1.5	0.83

Using the values above specified, each set of reinforcement is to be calculated in the same manner as slabs having supports on two sides only, but the total amount of reinforcement thus determined may be reduced 25%, by gradually increasing the rod spacing from the third point to the edge of the slab.

(*b*) That for beams, the bending moment at center and at support for interior spans be taken at $\frac{wl^2}{12}$, and for end spans it be taken at $\frac{wl^2}{10}$ for center and adjoining support, for both dead and live loads.

(*c*) In the case of beams and slabs continuous for two spans only, the bending moment at the central support should be taken as $\frac{wl^2}{8}$ and near the middle of the span as $\frac{wl^2}{10}$.

(*d*) At the ends of continuous beams, the amount of negative moment which will be developed will depend on the condition of restraint or fixedness, and this will depend on the form of construction used. There will usually be some restraint, and there is likely to be considerable. Provision should be made for the negative bending moment, but, as its amount will depend on the form of construction, the coefficient cannot be specified here, and must be left to the judgment of the designer.

For spans of unusual length, more exact calculations should be made. Special consideration is also required in the case of concentrated loads.

Even if the center of the span is designed for a greater bending moment than is called for by *a* or *b*, the negative moment at the support should not be taken as less than the values there given.

Where beams are reinforced on the compression side, the steel may be assumed to carry its proportion of stress, in accordance with the provisions of Chapter VII, Section 3, *c*-6. In the case of cantilever and continuous beams, tensile and compressive reinforcement over supports must extend sufficiently beyond the support and beyond the point of inflection to develop the requisite bond strength.

7.—Bond Strength, and Spacing of Reinforcement.

Adequate bond strength should be provided. The formula hereinafter given for bond stresses in beams is for straight longitudinal bars. In beams in which a portion of the reinforcement is bent up near the end, the bond stress at places in both the straight bars and the bent bars will be considerably greater than for all the bars straight, and the stress at some point may be several times as much as that found by considering the stress to be uniformly distributed along the bar. In restrained and cantilever beams, full tensile stress exists in the reinforcing bars at the point of support, and the bars must be anchored in the support sufficiently to develop this stress.

In case of anchorage of bars, an additional length of bar must be provided beyond that found on the assumption of uniform bond stress, for the reason that, before the bond resistance at the end of the bar can be developed, the bar may have begun to slip at another point, and "running" resistance is less than the resistance before slip begins.

Where high bond resistance is required, the deformed bar is a suitable means of supplying the necessary strength; but it should be recognized that, even with a deformed bar, initial slip occurs at early loads, and that the ultimate loads obtained in the usual tests for bond resistance may be misleading. Adequate bond strength throughout the length of a bar is preferable to end anchorage, but, as an additional safeguard, such anchorage may properly be used in special cases. Anchorage furnished by short bends at a right angle is less effective than hooks consisting of turns through 180 degrees.

The lateral spacing of parallel bars should not be less than three diameters, from center to center, nor should the distance from the side of the beam to the center of the nearest bar be less than two diameters. The clear spacing between two layers of bars should not be less than 1 in. The use of more than two layers is to be discouraged, unless the layers are tied together by adequate metal connections, particularly at and near points where bars are bent up or bent down.

8.—Diagonal Tension and Shear.

When a reinforced concrete beam is subjected to flexural action, diagonal tensile stresses are set up. If, in a beam not having web reinforcement, these stresses exceed the tensile strength of the concrete, failure of the beam will ensue. When web reinforcement, made up of stirrups, or of diagonal bars secured to the longitudinal reinforcement, or of longitudinal reinforcing bars bent up at several points, is used, new conditions prevail; but even in this case, at the beginning of loading, the diagonal tension developed is taken principally by the concrete, the deformations which are developed in the concrete permitting but little stress to be taken by the web reinforcement. When the resistance of the concrete to the diagonal tension is overcome at any point in the depth of the beam, greater stress is at once set up in the web reinforcement.

For homogeneous beams, the analytical treatment of diagonal tension is not very complex—the diagonal tensile stress is a function of the horizontal and vertical shearing stresses and of the horizontal tensile stress at the point considered, and as the intensity of these three stresses varies from the neutral axis to the remotest fiber, the intensity of the diagonal tension will be different at different points in the section, and will change with different proportionate dimensions of length to depth of beam. For the composite structure of reinforced concrete beams, an

analysis of the web stresses, and particularly of the diagonal tensile stresses is very complex; and when the variations due to a change from no horizontal tensile stress in the concrete at the remotest fiber to the presence of horizontal tensile stress at some point below the neutral axis are considered, the problem becomes more complex and indefinite. Under these circumstances, in designing, recourse is had to the use of the calculated vertical shearing stress as a means of comparing or measuring the diagonal tensile stresses developed, it being understood that the vertical shearing stress is not the numerical equivalent of the diagonal tensile stress, and even that there is not a constant ratio between them. It is here recommended that the maximum vertical shearing stress in a section be used as the means of comparison of the resistance to diagonal tensile stress developed in the concrete in beams not having web reinforcement.

Even after the concrete has reached its limit of resistance to diagonal tension, if the beam has web reinforcement, conditions of beam action will continue to prevail, at least through the compression area, and the web reinforcement will be called on to resist only a part of the web stresses. From experiments with beams, it is concluded that it is safe practice to use only two-thirds of the external vertical shear in making calculations of the stresses that come on stirrups, diagonal web pieces, and bent-up bars, and it is here recommended for calculations in designing that two-thirds of the external vertical shear be taken as producing stresses in web reinforcement.

Experiments bearing on the design of details of web reinforcement are not yet complete enough to allow more than general and tentative recommendations to be made. It is well established, however, that vertical members attached to or looped about horizontal members, inclined members secured to horizontal members in such a way as to insure against slip, and the bending of a part of the longitudinal reinforcement at an angle, will increase the strength of a beam against failure by diagonal tension, and that a well-designed and well-distributed web reinforcement may, under the best conditions, increase the total vertical shear carried to a value as much as three times that obtained when the bars are all horizontal and no web reinforcement is used. Where vertical stirrups are used without being secured to the longitudinal reinforcement, the force transmitted between longitudinal bar and stirrup must not be greater than can be taken through the concrete, and care must be taken to provide for the larger bond stress developed in the longitudinal bars with this construction than exists in the absence of stirrups. Sufficient bond resistance between the concrete and the stirrups or diagonals must be provided. Where the longitudinal bars are bent up, the points of bending of the several bars should be distributed along a portion of the length of the beam in such a way as to give efficient

web reinforcement over the portion of the length of the beam in which it is needed. The higher resistance to diagonal tension failures given by unit frames having the stirrups and bent-up bars securely connected together both longitudinally and laterally is worthy of recognition. It is necessary that a limit be placed on the amount of shear which may be allowed in a beam; for when web reinforcement sufficiently efficient to give very high web resistance is used, at the higher stresses the concrete in the beam becomes checked and cracked in such a way as to endanger its durability as well as its strength.

The section to be taken as the critical section in the calculation of shearing stresses will generally be the one having the maximum vertical shear, though experiments show that the section at which diagonal tension failures occur is not just at a support, even though the shear at the latter point be much greater.

The longitudinal spacing of stirrups or diagonal members, or the distribution of the points of bending of adjacent bent-up bars, should not exceed three-fourths the depth of the beam.

It is important that adequate bond strength or anchorage be provided to develop fully the assumed strength of all web reinforcement.

It should be noted that it is on the tension side of a beam that diagonal tension develops in a critical way, and that the proper connection must always be made between stirrups or other web reinforcement and the longitudinal tension reinforcement, whether the latter is on the lower side of the beam or on its upper side. Where negative moment exists, as is the case near the supports in a continuous beam, web reinforcement, to be effective, must be looped over, or wrapped around, or be connected with, the longitudinal tension reinforcing bars at the top of the beam, in the same way as is necessary at the bottom of the beam at sections where the bending moment is positive and the tension reinforcing bars are at the bottom of the beam.

Inasmuch as the smaller the longitudinal deformations in the horizontal reinforcement are, the less the tendency for the formation of diagonal cracks, a beam will be strengthened against diagonal tension failure by arranging and proportioning the horizontal reinforcement so that the unit stresses at points of large shear shall be relatively low.

Where pure shearing stress occurs, or shearing stress combined with but a small amount of tensile stress in the concrete, as when a concentrated load rests on a slab, or other forms of punching shear are produced, or in the case of compression pieces, the element of tension will not need consideration, and the permissible limit of the shearing stress will be higher than the allowable limit when this stress is used as a means of comparing diagonal tensile stress. The working values recommended are given in Chapter VIII, Working Stresses.

9.—Columns.

By columns are meant compression members of which the ratio of unsupported length to least width exceeds about six, and which are provided with reinforcement of one of the forms hereafter described.

It is recommended that the ratio of unsupported length of column to its least width be limited to 15.

The effective area of the column shall be taken as the area within the protective covering, as defined in Chapter VI, Section 3; or, in the case of hooped columns or columns reinforced with structural shapes, it shall be taken as the area within the hooping or structural shapes.

Columns may be reinforced by longitudinal bars, by bands, hoops, or spirals, together with longitudinal bars, or by structural forms which in themselves are sufficiently rigid to act as columns. The general effect of closely spaced hooping is greatly to increase the "toughness" of the column and its ultimate strength, but hooping has little effect on its behavior within the limit of elasticity. It thus renders the concrete a safer and more reliable material, and should permit the use of a somewhat higher working stress. The beneficial effects of "toughening" are adequately provided by a moderate amount of hooping, a larger amount serving mainly to increase the ultimate strength and the possible deformation before ultimate failure.

Composite columns of structural steel and concrete in which the steel forms a column by itself, should be designed with caution. To classify this type as a concrete column reinforced with structural steel is hardly permissible, as the steel will generally take the greater part of the load. When this type of column is used, the concrete should not be relied on to tie the steel units together or to transmit stresses from one unit to another. The units should be adequately tied together by tie-plates or lattice bars, which, together with other details, such as splices, etc., should be designed in conformity with standard practice for structural steel. The concrete may exert a beneficial effect in restraining the steel from lateral deflection, and also in increasing the carrying capacity of the column. The proportion of load to be carried by the concrete will depend on the form of the column and the method of construction. Generally, for high percentages of steel, the concrete will develop relatively low unit stresses, and caution should be used in placing dependence on the concrete.

The following recommendations are made for the relative working stresses in the concrete for the several types of columns:

(*a*) Columns with longitudinal reinforcement only, to the extent of not less than 1% and not more than 4%: the unit stress recommended for axial compression in Chapter VIII, Section 3.

(*b*) Columns with reinforcement of bands, hoops, or spirals, as hereinafter specified: stresses 20% higher than given for *a*, provided the ratio of the unsupported length of the column to the diameter of the hooped core is not more than 8.

(*c*) Columns reinforced with not less than 1% and not more than 4% of longitudinal bars, and with bands, hoops, or spirals, as hereinafter specified: stresses 45% higher than given for *a*, provided the ratio of the unsupported length of the column to the diameter of the hooped core is not more than 8.

The foregoing recommendations are based on the following conditions:

In all cases, longitudinal reinforcement is assumed to carry its proportion of stress, in accordance with Section 3. The hoops or bands are not to be counted on directly as adding to the strength of the column.

Bars composing longitudinal reinforcement shall be straight, and shall have sufficient lateral support to be securely held in place until the concrete has set.

Where hooping is used, the total amount of such reinforcement shall be not less than 1% of the volume of the column enclosed. The clear spacing of such hooping shall be not greater than one-sixth of the diameter of the enclosed column, and preferably not greater than one-tenth, and in no case more than 2½ in. Hooping is to be circular, and the ends of bands must be united in such a way as to develop their full strength. Adequate means must be provided to hold bands or hoops in place so as to form a column, the core of which shall be straight and well centered. The strength of hooped columns depends very much on the ratio of length to diameter of hooped core, and the strength due to hooping decreases rapidly as this ratio increases beyond five. The working stresses recommended are for hooped columns with a length of not more than eight diameters of the hooped core.

Bending stresses due to eccentric loads and lateral forces must be provided for by increasing the section until the maximum stress does not exceed the values above specified; and, where tension is possible in the longitudinal bars, adequate connection between the ends of the bars must be provided to take this tension.

10.—Reinforcing for Shrinkage and Temperature Stresses.

When areas of concrete too large to expand and contract freely as a whole are exposed to atmospheric conditions, the changes of form due to shrinkage (resulting from hardening) and to action of temperature are such that cracks may occur in the mass, unless precautions are taken to distribute the stresses so as to prevent the cracks alto-

gether, or to render them very small. The distance apart of the cracks, and consequently their size, will be directly proportional to the diameter of the reinforcement and to the tensile strength of the concrete, and inversely proportional to the percentage of reinforcement and also to its bond resistance per unit of surface area. To be most effective, therefore, reinforcement (in amount generally not less than one-third of 1%) of a form which will develop a high bond resistance should be placed near the exposed surface and be well distributed. The allowable size and spacing of cracks depends on various considerations, such as the necessity for water-tightness, the importance of appearance of the surface, and the atmospheric changes.

VIII. Working Stresses.

1.—General Assumptions.

The following working stresses are recommended for static loads. Proper allowances for vibration and impact are to be added to live loads where necessary to produce an equivalent static load before applying the unit stresses in proportioning parts.

In selecting the permissible working stress to be allowed on concrete, we should be guided by the working stresses usually allowed for other materials of construction, so that all structures of the same class but composed of different materials may have approximately the same degree of safety.

The following recommendations as to allowable stresses are given in the form of percentages of the ultimate strength of the particular concrete which is to be used; this ultimate strength is to be that developed in cylinders 8 in. in diameter and 16 in. long of the consistency described in Chapter IV, Section 2 (*a*), made and stored under laboratory conditions, at an age of 28 days. In the absence of definite knowledge, in advance of construction, as to just what strength may be expected, the Committee submits the following values as those which should be obtained with materials and workmanship in accordance with the recommendations of this report.

Although occasional tests may show higher results than those here given, the Committee recommends that these values should be the maximum used in design.

Table of Strengths of Different Mixtures of Concrete.
(In Pounds per Square Inch.)

Aggregate.	1:1:2	1:1½:3	1:2:4	1:2½:5	1:3:6
Granite, trap rock	3 300	2 800	2 200	1 800	1 400
Gravel, hard limestone and hard sandstone.	3 000	2 500	2 000	1 600	1 300
Soft limestone and sandstone	2 200	1 800	1 500	1 200	1 000
Cinders.	800	700	600	500	400

Note.—For variations in the moduli of elasticity see Chapter VIII, Section 8.

2.—Bearing.

When compression is applied to a surface of concrete of at least twice the loaded area, a stress of 32.5% of the compressive strength may be allowed.

3.—Axial Compression.

For concentric compression on a plain concrete column or pier, the length of which does not exceed 12 diameters, 22.5% of the compressive strength may be allowed.

For other forms of columns the stresses obtained from the ratios given in Chapter VII, Section 9, may govern.

4.—Compression in Extreme Fiber.

The extreme fiber stress of a beam, calculated on the assumption of a constant modulus of elasticity for concrete under working stresses, may be allowed to reach 32.5% of the compressive strength. Adjacent to the support of continuous beams stresses 15% higher may be used.

5.—Shear and Diagonal Tension.

In calculations on beams in which the maximum shearing stress in a section is used as the means of measuring the resistance to diagonal tension stress, the following allowable values for the maximum vertical shearing stress are recommended:

(*a*) For beams with horizontal bars only and without web reinforcement calculated by the method given in the Appendix, Formula (22): 2% of the compressive strength.

(*b*) For beams thoroughly reinforced with web reinforcement: the value of the shearing stress calculated as for *a* (that is, using the total external vertical shear in Formula (22) for shearing unit stress), must not exceed 6% of the compressive strength. The web reinforcement, exclusive of bent-up bars, in this case, shall be proportioned to resist two-thirds of the external vertical shear in the formulas given in the Appendix, Formulas (24) or (25).

(*c*) For beams in which part of the longitudinal reinforcement is used in the form of bent-up bars distributed over a portion of the beam in a way covering the requirements for this type of web reinforcement: the limit of maximum vertical shearing stress (the stress calculated as for *a*), 3% of the compressive strength.

(*d*) Where punching shear occurs, that is, shearing stress uncombined with compression normal to the shearing surface, and with all tension normal to the shearing plane provided for by reinforcement: a shearing stress of 6% of the compressive strength may be allowed.

6.—Bond.

The bond stress between concrete and plain reinforcing bars may be assumed at 4% of the compressive strength, or 2% in the case of drawn wire.

7.—Reinforcement.

The tensile or compressive strength in steel should not exceed 16 000 lb. per sq. in.

In structural steel members, the working stresses adopted by the American Railway Engineering Association are recommended.

8.—Modulus of Elasticity.

The value of the modulus of elasticity of concrete has a wide range, depending on the materials used, the age, the range of stresses between which it is considered, as well as other conditions. It is recommended that in computations for the position of the neutral axis and for the resisting moment of beams and for the compression of concrete in columns it be assumed as:

(*a*) One-fifteenth of that of steel, when the strength of the concrete is taken as 2 200 lb. per. sq. in. or less.

(*b*) One-twelfth of that of steel, when the strength of the concrete is taken as greater than 2 200 lb. per sq. in., or less than 2 900 lb. per sq. in., and

(*c*) One-tenth of that of steel, when the strength of the concrete is taken as greater than 2 900 lb. per sq. in.

Although not rigorously accurate, these assumptions will give safe results. For the deflection of beams which are free to move longitudinally at the supports, in using formulas for deflection which do not take into account the tensile strength developed in the concrete, a modulus one-eighth of that of steel is recommended.

Respectfully submitted,

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DECEMBER, 1912.

IX. Appendix.

1.—Standard Specifications.

(*a*) *Cement.**

GENERAL OBSERVATIONS.

1.—These remarks have been prepared with a view of pointing out the pertinent features of the various requirements and the precautions to be observed in the interpretation of the results of the tests.

2.—The Committee would suggest that the acceptance or rejection under these specifications be based on tests made by an experienced person having the proper means for making the tests.

SPECIFIC GRAVITY.

3.—Specific gravity is useful in detecting adulteration. The results of tests of specific gravity are not necessarily conclusive as an indication of the quality of a cement, but when in combination with the results of other tests may afford valuable indications.

FINENESS.

4.—The sieves should be kept thoroughly dry.

TIME OF SETTING.

5.—Great care should be exercised to maintain the test pieces under as uniform conditions as possible. A sudden change or wide range of temperature in the room in which the tests are made, a very dry or humid atmosphere, and other irregularities, vitally affect the rate of setting.

CONSTANCY OF VOLUME.

6.—The tests for constancy of volume are divided into two classes, the first normal, the second accelerated. The latter should be regarded as a precautionary test only, and not infallible. So many conditions enter into the making and interpreting of it that it should be used with extreme care.

7.—In making the pats, the greatest care should be exercised to avoid initial strains due to moulding or to too rapid drying-out during the first 24 hours. The pats should be preserved under the most uniform conditions possible, and rapid changes of temperature should be avoided.

8.—The failure to meet the requirements of the accelerated tests need not be sufficient cause for rejection. The cement, however, may be held for 28 days, and a retest made at the end of that period, using a new sample. Failure to meet the requirements at this time should be considered sufficient cause for rejection, although in the present state of our

* Adopted August 16th, 1909, by the American Society for Testing Materials.

knowledge it cannot be said that such failure necessarily indicates unsoundness, nor can the cement be considered entirely satisfactory simply because it passes the tests.

General Conditions.

1. All cement shall be inspected.

2. Cement may be inspected either at the place of manufacture or on the work.

3. In order to allow ample time for inspecting and testing, the cement should be stored in a suitable weather-tight building having the floor properly blocked or raised from the ground.

4. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment.

5. Every facility shall be provided by the contractor, and a period of at least 12 days allowed for the inspection and necessary tests.

6. Cement shall be delivered in suitable packages, with the brand and name of manufacturer plainly marked thereon.

7. A bag of cement shall contain 94 lb. of cement net. Each barrel of Portland cement shall contain 4 bags, and each barrel of natural cement shall contain 3 bags of the above net weight.

8. Cement failing to meet the 7-day requirements may be held awaiting the results of the 28-day tests before rejection.

9. All tests shall be made in accordance with the methods proposed by the Special Committee on Uniform Tests of Cement of the American Society of Civil Engineers, presented to the Society on January 17th, 1912, with all subsequent amendments thereto.

10. The acceptance or rejection shall be based on the following requirements:

Natural Cement.

11. *Definition.*—This term shall be applied to the finely pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to drive off the carbonic acid gas.

FINENESS.

12. It shall leave by weight a residue of not more than 10% on the No. 100, and 30% on the No. 200 sieve.

TIME OF SETTING.

13. It shall not develop initial set in less than 10 min., and shall not develop hard set in less than 30 min., or more than 3 hours.

TENSILE STRENGTH.

14. The minimum requirements for tensile strength for briquettes 1 sq. in. in cross-section shall be as follows, and the cement shall show no retrogression in strength within the periods specified:

Age.	*Neat Cement.*	Strength.
24 hours in moist air		75 lb.
7 days (1 day in moist air, 6 days in water)		150 "
28 days (1 day in moist air, 27 days in water)		250 "
	One Part Cement, Three Parts Standard Ottawa Sand.	
7 days (1 day in moist air, 6 days in water)		50 lb.
28 days (1 day in moist air, 27 days in water)		125 "

CONSTANCY OF VOLUME.

15. Pats of neat cement about 3 in. in diameter, ½ in. thick at the center, tapering to a thin edge, shall be kept in moist air for a period of 24 hours.

(*a*) A pat is then kept in air at normal temperature.

(*b*) Another is kept in water maintained as near 70° Fahr. as practicable.

16. These pats are observed at intervals for at least 28 days, and, to pass the tests satisfactorily, should remain firm and hard and show no signs of distortion, checking, cracking, or disintegrating.

PORTLAND CEMENT.

17. *Definition.*—This term is applied to the finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition greater than 3% has been made subsequent to calcination.

SPECIFIC GRAVITY.

18. The specific gravity of cement shall be not less than 3.10. Should the test of cement as received fall below this requirement, a second test may be made on a sample ignited at a low red heat. The loss in weight of the ignited cement shall not exceed 4 per cent.

FINENESS.

19. It shall leave by weight a residue of not more than 8% on the No. 100, and not more than 25% on the No. 200 sieve.

TIME OF SETTING.

20. It shall not develop initial set in less than 30 min.; and must develop hard set in not less than 1 hour, nor more than 10 hours.

TENSILE STRENGTH.

21. The minimum requirements for tensile strength for briquettes 1 sq. in. in cross-section shall be as follows, and the cement shall show no retrogression in strength within the periods specified:

Age.	*Neat Cement.*	Strength.
24 hours in moist air		175 lb.
7 days (1 day in moist air, 6 days in water)		500 "
28 days (1 day in moist air, 27 days in water)		600 "
	One Part Cement, Three Parts Standard Ottawa Sand.	
7 days (1 day in moist air, 6 days in water)		200 lb.
28 days (1 day in moist air, 27 days in water)		275 "

CONSTANCY OF VOLUME.

22. Pats of neat cement about 3 in. in diameter, ½ in. thick at the center, and tapering to a thin edge, shall be kept in moist air for a period of 24 hours.

(*a*) A pat is then kept in air at normal temperature and observed at intervals for at least 28 days.

(*b*) Another pat is kept in water maintained as near 70° Fahr. as practicable, and observed at intervals for at least 28 days.

(*c*) A third pat is exposed in any convenient way in an atmosphere of steam, above boiling water, in a loosely closed vessel for 5 hours.

23. These pats, to pass the requirements satisfactorily, shall remain firm and hard, and show no signs of distortion, checking, cracking, or disintegrating.

SULPHURIC ACID AND MAGNESIA.

24. The cement shall not contain more than 1.75% of anhydrous sulphuric acid (SO_3), nor more than 4% of magnesia (MgO).

(*b*) *Metal Reinforcement.**

6.—Steel shall be made by the open-hearth process. Re-rolled material will not be accepted.

7.—Plates and shapes used for reinforcement shall be of structural steel only. Bars and wire may be of structural steel or high-carbon steel.

8.—The chemical and physical properties shall conform to the following limits:

Elements Considered.	Structural Steel.	High-Carbon Steel.
Phosphorus, maximum { Basic	0.04 per cent.	0.04 per cent.
{ Acid	0.06 " "	0.06 " "
Sulphur, maximum	0.05 " "	0.05 " "
Ultimate tensile strength.	Desired.	Desired.
Pounds, per square inch	60 000	88 000
	1 500 000†	1 000 000
Elong. min. percentage in 8 in., Fig. 1	Ult. tensile strength.	Ult. tensile strength.
Character of fracture	Silky	{ Silky or finely granular.
Cold bends without fracture	180° flat‡	180° $d = 4t$ §

* Adopted March 16th, 1910, by the American Railway Engineering Association.
† See Paragraph 15. ‡ See Paragraphs 16 and 17. § "$d = 4t$" signifies "around a pin having a diameter four times the thickness of the specimen."

9.—The yield point for bars and wire, as indicated by the drop of the beam, shall be not less than 60% of the ultimate tensile strength.

10.—If the ultimate strength varies more than 4 000 lb. for structural steel or 6 000 lb. for high-carbon steel, a retest shall be made on the same gauge, which, to be acceptable, shall be within 5 000 lb. for structural steel, or 8 000 lb. for high-carbon steel, of the desired ultimate.

11.—Chemical determinations of the percentages of carbon, phosphorus, sulphur, and manganese shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt of steel, and a correct copy of such analysis shall be furnished to the engineer or his inspector. Check analyses shall be made from finished material, if called for, in which case an excess of 25% above the required limits will be allowed.

12.—Plates, Shapes, and Bars.—Specimens for tensile and bending tests for plates and shapes shall be made by cutting, from the finished product, coupons which shall have both faces rolled and both edges

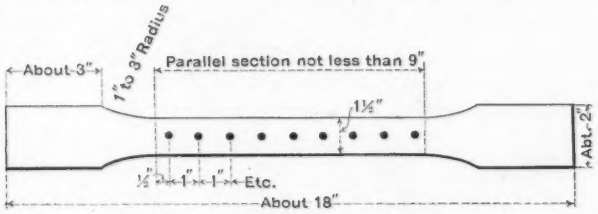


FIG. 1.—TENSION TEST PIECE.

milled to the form shown by Fig. 1; or with both edges parallel; or they may be turned to a diameter of ¾ in. with enlarged ends.

13.—Bars shall be tested in their finished form.

14.—At least one tensile and one bending test shall be made from each melt of steel as rolled. In case steel differing ⅜ in. and more in thickness is rolled from one melt, a test shall be made from the thickest and thinnest material rolled.

15.—For material less than $\frac{5}{16}$ in. and more than ¾ in. in thickness the following modifications will be allowed in the requirements for elongation:

(*a*) For each $\frac{1}{16}$ in. in thickness below $\frac{5}{16}$ in., a deduction of 2½ will be allowed from the specified percentage.

(*b*) For each ⅛ in. in thickness above ¾ in., a deduction of 1 will be allowed from the specified percentage.

16.—Bending tests may be made by pressure or by blows. Shapes and bars less than 1 in. thick shall bend as called for in Paragraph 8.

17.—Test specimens 1 in. thick and greater shall bend cold 180° around a pin, the diameter of which, for structural steel, is twice the

thickness of the specimen, and for high-carbon steel, is six times the thickness of the specimen, without fracture on the outside of the bend.

18.—Finished material shall be free from injurious seams, flaws, cracks, defective edges, or other defects, and have a smooth, uniform, and workmanlike finish.

19.—Every finished piece of steel shall have the melt number and the name of the manufacturer stamped or rolled on it, except that bar steel and other small parts may be bundled, with the above marks on an attached metal tag.

20.—Material which, subsequent to the above tests at the mills, and its acceptance there, develops weak spots, brittleness, cracks, or other imperfections, or is found to have injurious defects, will be rejected, and shall be replaced by the manufacturer at his own cost.

21.—All reinforcing steel shall be free from excessive rust, loose scale, or other coatings of any character which would reduce or destroy the bond.

2.—Suggested Formulas for Reinforced Concrete Construction.

These formulas are based on the assumptions and principles given in the chapter on design.

(*a*) *Standard Notation.*

1.—Rectangular Beams.

The following notation is recommended:

f_s = tensile unit stress in steel,
f_c = compressive unit stress in concrete,
E_s = modulus of elasticity of steel,
E_c = modulus of elasticity of concrete,
$n = \frac{E_s}{E_c}$,
M = moment of resistance, or bending moment in general,
A = steel area,
b = breadth of beam,
d = depth of beam to center of steel,
k = ratio of depth of neutral axis to effective depth d,
z = depth of resultant compression below top,
j = ratio of lever arm of resisting couple to depth d,
$jd = d - z$ = arm of resisting couple,
p = steel ratio (not percentage).

2.—T-Beams.

b = width of flange,
b' = width of stem,
t = thickness of flange.

3.—Beams Reinforced for Compression.

A' = area of compressive steel,
p' = steel ratio for compressive steel,
f_s' = compressive unit stress in steel,
C = total compressive stress in concrete,
C' = total compressive stress in steel,
d' = depth to center of compressive steel,
z = depth to resultant of C and C'.

4.—Shear and Bond.

V = total shear,
v = shearing unit stress,
u = bond stress per unit area of bar,
o = circumference or perimeter of bar,
Σ_0 = sum of the perimeters of all bars.

5.—Columns.

A = total net area,
A_s = area of longitudinal steel,
A_c = area of concrete,
P = total safe load.

(*b*) *Formulas.*

1.—Rectangular Beams.

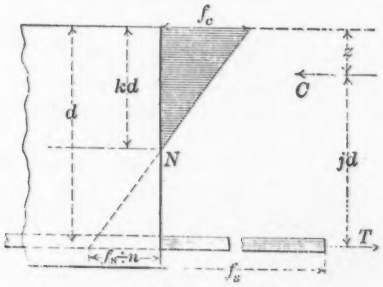


FIG. 2.

Position of neutral axis,

$$k = \sqrt{2\,pn + (pn)^2} - pn \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Arm of resisting couple,

$$j = 1 - \frac{1}{3}\,k \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

(For f_s = 15 000 to 16 000, and f_c = 600 to 650, k may be taken at $\frac{3}{8}$.)

Fiber stresses,

$$f_s = \frac{M}{Ajd} = \frac{M}{pjbd^2} \quad \ldots\ldots (3)$$

$$f_c = \frac{2M}{jkbd^2} = \frac{2pf_s}{k} \quad \ldots\ldots (4)$$

Steel ratio, for balanced reinforcement,

$$p = \frac{1}{2} \frac{1}{\frac{f_s}{f_c}\left(\frac{f_s}{nf_c} + 1\right)} \quad \ldots\ldots (5)$$

2.—T-Beams.

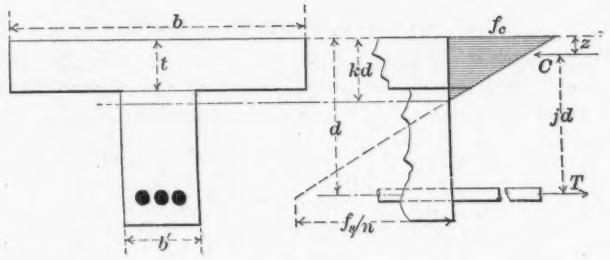


FIG. 3.

Case I. When the neutral axis lies in the flange.

Use the formulas for rectangular beams.

Case II. When the neutral axis lies in the stem.

The following formulas neglect the compression in the stem:

Position of neutral axis,

$$kd = \frac{2\,nd\,A + bt^2}{2\,n\,A + 2\,bt} \quad \ldots\ldots (6)$$

Position of resultant compression,

$$z = \frac{3\,kd - 2\,t}{2\,kd - t}\,\frac{t}{3} \quad \ldots\ldots (7)$$

Arm of resisting couple,

$$jd = d - z \quad \ldots\ldots (8)$$

Fiber stresses,

$$f_s = \frac{M}{Ajd} \quad \ldots\ldots (9)$$

$$f_c = \frac{Mkd}{bt\left(kd - \frac{1}{2}\,t\right)jd} = \frac{f_s}{n}\,\frac{k}{1-k} \quad \ldots\ldots (10)$$

(For approximate results, the formulas for rectangular beams may be used.)

The following formulas take into account the compression in the stem; they are recommended where the flange is small compared with the stem:

Position of neutral axis,

$$kd = \sqrt{\frac{2\,nd\,A + (b - b')\,t^2}{b'} + \left(\frac{nA + (b - b')\,t}{b'}\right)^2} - \frac{nA + (b - b')\,t}{b'} \quad \ldots\ldots (11)$$

Position of resultant compression,

$$z = \frac{\left(kdt^2 - \frac{2}{3}\,t^3\right) b + \left[(kd - t)^2 \left(t + \frac{1}{3}\,(kd - t)\right)\right] b'}{t\,(2\,kd - t)\,b + (kd - t)^2\,b'} \quad \ldots\ldots (12)$$

Arm of resisting couple,

$$jd = d - z \quad \ldots\ldots (13)$$

Fiber stresses,

$$f_s = \frac{M}{Ajd} \quad \ldots\ldots (14)$$

$$f_c = \frac{2\,Mkd}{[(2\,kd - t)\,bt + (kd - t)^2\,b']\,jd} \quad \ldots\ldots (15)$$

3.—Beams Reinforced for Compression.

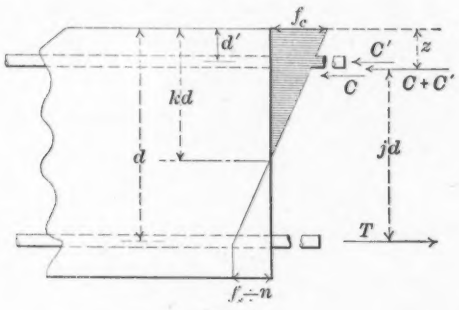


FIG. 4.

Position of neutral axis,

$$k = \sqrt{2\,n\left(p + p'\,\frac{d'}{d}\right) + n^2\,(p + p')^2} - n\,(p + p') \quad \ldots\ldots (16)$$

Position of resultant compression,

$$z = \frac{\frac{1}{3}\,k^3\,d + 2\,p'\,nd'\left(k - \frac{d'}{d}\right)}{k^2 + 2\,p'\,n\left(k - \frac{d'}{d}\right)} \quad \ldots\ldots (17)$$

Arm of resisting couple,

$$jd = d - z \quad \ldots\ldots (18)$$

Fiber stresses,

$$f_c = \frac{6\,M}{bd^2\left[3\,k - k^2 + \frac{6\,p'\,n}{k}\left(k - \frac{d'}{d}\right)\left(1 - \frac{d'}{d}\right)\right]} \quad \ldots\ldots (19)$$

$$f_s = \frac{M}{pjbd^2} = nf_c\,\frac{1-k}{k} \quad \ldots\ldots (20)$$

$$f_s' = nf_c\,\frac{k - \frac{d'}{d}}{k} \quad \ldots\ldots (21)$$

4.—Shear, Bond, and Web Reinforcement.

In the following formulas, Σ_0 refers only to the bars constituting the tension reinforcement at the section in question, and jd is the lever arm of the resisting couple at the section.

For rectangular beams,

$$v = \frac{V}{bjd} \quad \ldots\ldots (22)$$

$$u = \frac{V}{jd\ \Sigma_0} \quad \ldots\ldots (23)$$

$\left(\text{For approximate results, } j \text{ may be taken at } \frac{7}{8}.\right)$

The stresses in web reinforcement may be estimated by the following formulas:

Vertical web reinforcement,

$$P = \frac{Vs}{jd} \quad \ldots\ldots (24)$$

Web reinforcement inclined at 45° (not bent-up bars),

$$P = 0.7\,\frac{Vs}{jd} \quad \ldots\ldots (25)$$

in which P = stress in single reinforcing member, V = amount of total shear assumed as carried by the reinforcement, and s = horizontal spacing of the reinforcing members.

The same formulas apply to beams reinforced for compression as regards shear and bond stress for tensile steel.

For T-beams,

$$v = \frac{V}{b'\,jd} \quad \ldots\ldots (26)$$

$$u = \frac{V}{jd\ \Sigma_0} \quad \ldots\ldots (27)$$

$\left(\text{For approximate results, } j \text{ may be taken at } \frac{7}{8}.\right)$

5.—Columns.

Total safe load,

$$P = f_c (A_c + nA_s) = f_c A (1 + (n - 1) p) \ldots\ldots\ldots (28)$$

Unit stresses,

$$f_c = \frac{P}{A (1 + (n - 1) p)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (29)$$

$$f_s = n f_c \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (30)$$

PROGRESS REPORT OF SPECIAL COMMITTEE ON ENGINEERING EDUCATION.

JANUARY, 1913.

During the past year the Committee has lost one of its most active members, Past-President B. M. Harrod, who, from the very beginning of the investigation, took an interest in the endeavor to co-ordinate the diverse views entertained by the Profession on almost every phase of Engineering Education.

As the work of the Committee is drawing to a close it is not proposed to fill the vacancy caused by Mr. Harrod's lamented death.

At the time of the last Annual Meeting an understanding had been arrived at with the Carnegie Foundation that they would undertake a comprehensive investigation into the subject of Engineering Education, such an investigation as they had already made into the matter of Medical Education, involving the expenditure of a large sum of money, with satisfactory results.

Owing to the ill health of Dr. Pritchett and his long absence in California, no practical results could be arrived at, but it is now hoped that in a very short time the work will begin.

As the Committee may still be of some service until the new organization is under way, we ask to be continued for another year.

DESMOND FITZGERALD, *Chairman,*
ONWARD BATES,
DANIEL W. MEAD.

PROGRESS REPORT OF THE SPECIAL COMMITTEE ON STEEL COLUMNS AND STRUTS.

JANUARY 15TH, 1913.

The Special Committee "to consider and report upon the design, ultimate strength, and safe working values of Steel Columns and Struts," presents the following report of progress:

Your Committee submits the proposed programme of 144 column tests as outlined and agreed upon with the representatives of the Bureau of Standards, of the United States Government, S. W. Stratton, Director.

It will be seen that the programme is arranged with the intention, as far as practicable, of eliminating all variables except that of form. The programme is subdivided so as to consider the effect of light and heavy sections. It will be noted, from the accompanying specifications, that the requirements for the material are extremely rigid; in fact, far above the commercial grade. It is expected that the uniform material produced by these specifications will reduce erratic results to a minimum. Your Committee feels that, when the results of these proposed tests of special material have been studied and correlated, the knowledge gained hereby will enable engineers to draw conclusions regarding the action, under load, of columns made of commercial grades of steel.

When its last Progress Report was made, your Committee expected to have the results of this programme for study before now, and to be able to report on the results at this meeting, but it regrets to state that the 2 300 000-lb. testing machine now being installed by the U. S. Government at Washington is not yet ready for operation. The Bureau of Standards writes that the machine will be finished in the near future; that the material for the first half of the programme has been purchased from the American Bridge Company, and that the programme of tests mentioned in this report will be the first to be undertaken.

Your Committee has been unable to avail itself of most of the tests which it has thus far recorded, owing to lack of data regarding the material used. Suggestions have been made regarding the use of discarded columns taken from old structures. If such series of tests are to be of value for comparison with other series, the complete history of the metal should be known.

Last year, your Committee reported that it was in communication with the Committee of the American Railway Engineering Association on Iron and Steel Structures, with a view to the two Committees working in harmony. The sub-committee on Iron and Steel Structures of that Association, W. H. Moore, Chairman, expects to make other series of tests which, correlated with ours, will further the knowledge

of the subject. During the past year the committees of the two Societies have kept in close touch, and their conferences have been of mutual advantage.

Through the loss of its honored member, Mr. Alfred P. Boller, your Committee has been deprived of the wise council and keen judgment of an able and cultured engineer.

Your Committee will be unable to make a final report until the results of the proposed programme are available for study.

For the Committee:

AUSTIN LORD BOWMAN, *Chairman,*
LEWIS D. RIGHTS, *Secretary.*

Committee:

AUSTIN LORD BOWMAN,
EMIL GERBER,
CHAS. F. LOWETH,
RALPH MODJESKI,
FRANK C. OSBORN,
GEO. H. PEGRAM,
GEO. F. SWAIN,
LEWIS D. RIGHTS,
EMIL SWENSSON,
J. R. WORCESTER.

TABLE OF CHEMICAL AND PHYSICAL PROPERTIES FOR SPECIAL SPECIFICATIONS FOR UNIFORM QUALITY STRUCTURAL STEEL FOR COMPARATIVE COLUMN TESTS FOR THE BUREAU OF STANDARDS, U. S. GOVERNMENT.

Material.—Basic open-hearth structural steel.

Chemical.—Uniformity is paramount, and must be aimed for.

Carbon.—The percentage of carbon must not vary more than just to insure the desired physical properties in required sections of material.

Manganese	0.40% min. and 0.50% max.
Phosphorus	0.00% min. and 0.03% max.
Sulphur	0.00% min. and 0.04% max.
Silicon	0.00% min. and 0.10% max.
Nickel	0.00% min. and 0.05% max.
Chromium	0.00% min. and 0.05% max.
Copper	0.00% min. and 0.03% max.
All possible others	0.00%

Physical.—The desired physical properties must be aimed for.

Ultimate tensile strength	Desired, 60 000 lb. per sq. in. (may vary 1 500 lb. either way.)
Elastic limit (yield point)	Desired, 38 000 lb. per sq. in. (may vary 1 000 lb. either way.)
Elongation in 8 in.	Desired, 28% (may vary 2% either way.)
Reduction in area	Desired, 56% (may vary 4% either way.)
Character of fracture	Silky, cup.
Cold bend without fracture	180°, flat, on itself.

Specifications for Workmanship for Special Test Columns for the Bureau of Standards, U. S. Government.

In general, the American Railway Engineering Association Specifications will govern this work, with the following changes and additions thereto:

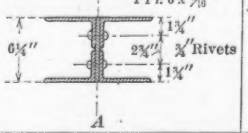
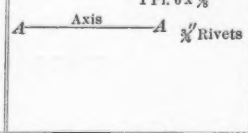
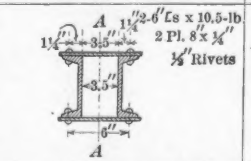
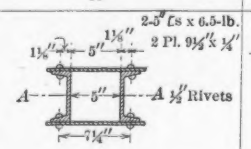
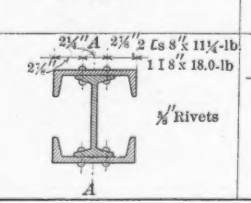
The workmanship required for these columns is to be gild-edged.

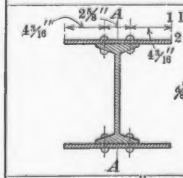
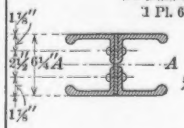
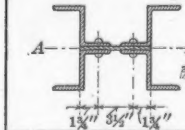
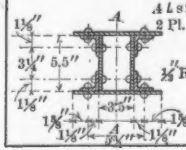
Each piece of rolled material is to be absolutely true to dimensions and made absolutely straight.

The punching must be exact, and holes must be $\frac{3}{16}$ in. smaller than diameter of rivet. The holes must be reamed when pieces are assembled into columns.

The columns will be riveted by stitch-riveting them on alternate sides, in order to prevent warping, and to produce absolutely straight columns. Slight deviations from a straight line of axis, changes in sections or windings, etc., must be carefully removed, so as to produce the most perfect column shafts possible.

Facing of ends to be absolutely at right angles to axis of column, and thus, of course, parallel to each other.

Light Section.	Area, in Square Inches.	r	$\frac{l}{r}$	Length.	Heavy Section.	Area, in Square Inches	r	$\frac{l}{r}$	Length.
 4 Ls 5″ x 3″ x 5/16″ 1 Pl. 6″ x 5/16″ ⅞″ Rivets	9.60 1.875 11.475	2.24	120 85 50	22′4 13/16″ 15′10 7/16″ 9′4″	 4 Ls 5″ x 3″ x ⅝″ 1 Pl. 6″ x ⅝″ ⅞″ Rivets	18.44 3.75 22.19	2.36	120 85 50	23′7 3/16″ 16′8 9/16″ 9′10″
 2-6″ Cs x 10.5-lb. 2 Pl. 8″ x ¼″ ⅛″ Rivets	6.18 4.00 10.18	2.31	120 85 50	23′1 3/16″ 16′4 3/16″ 9′7½″	2-6″ Cs x 15.5-lb. 2 Pl. 8″ x ½″ ½″ Rivets	9.12 8.00 17.12	2.33	120 85 50	23′3 9/16″ 16′6 1/16″ 9′8½″
 2-5″ Cs x 6.5-lb. 2 Pl. 9½″ x ¼″ ½″ Rivets	3.90 4.75 8.65	2.34	120 85 50	23′4 13/16″ 16′6 1/16″ 9′9″	2 Cs 5″ x 11.5-lb. 2 Pl. 9½″ x ½″ ½″ Rivets	6.76 9.50 16.26	2.39	120 85 50	23′10 13/16″ 16′11 1/16″ 9′11½″
 2 Cs 8″ x 11½-lb. 1 I 8″ x 18.0-lb ⅝″ Rivets	6.70 5.33 12.03	2.38	120 85 50	23′9 5/16″ 16′10 5/16″ 9′11″	2 Cs 8″ x 18.75-lb. 1 I 8″ x 20.50-lb. ⅝″ Rivets	11.02 6.03 17.05	2.32	120 85 50	23′2 1/16″ 16′5 1/16″ 9′8″

Light Section.	Area, in Square Inches.	r	$\frac{l}{r}$	Length.	Heavy Section.	Area, in Square Inches.	r	$\frac{l}{r}$	Length.
 1 I 10″ x 25-lb. 2 Pl. 11″ x ⅝″ ⅞″ Rivets	7.37 6.88 14.25	2.31	120 85 50	23′1⅛₁₆″ 16′4⅜₁₆″ 9′7½₁₆″	1 I 10″ x 35-lb. 2 Pl. 11″ x ⅝″ ⅞″ Rivets	10.29 13.75 24.04	2.47	120 85 50	24′8⅜₁₆″ 17′5¹⁵⁄₁₆″ 10′3¼₁₆″
 4-5″ Bulb I beam x10.1-lb. 1 Pl. 6″ x ⅝₁₆″ ⅞″ Rivets	11.88 1.88 13.76	2.48	120 85 50	24′9⅝₁₆″ 17′6¹³⁄₁₆″ 10′4″	4-5″ Bulb I beam x13.5-lb. 1 Pl. 6″ x ⅞₁₆″ ⅞″ Rivets	15.88 2.63 18.51	2.42	120 85 50	24′2⅜₁₆″ 17′1¹¹⁄₁₆″ 10′1″
 4-4″ Z's x ¼″ 1 Pl. 7″ x ¼″ ⅞″ Rivets	9.64 1.75 11.39	2.46	120 85 50	24′7⅝₁₆″ 17′5¼₁₆″ 10′3″	4-4″ Z's x ⅜″ 1 Pl. 7″ x ⅜″ ⅞″ Rivets	22.20 4.38 26.58	2.51	120 85 50	25′1⅞₁₆″ 17′9⅜₁₆″ 10′5½₁₆″
 2 Pl. 9″ x ¼″ 4 L s 2″ x 2″ x ¼″ 2 Pl. 5¼″ x ¼″ ½″ Rivets	4.500 3.760 2.625 10.885	2.33	120 85 50	23′3⅝₁₆″ 16′6½₁₆″ 9′8½₁₆″	2 Pl. 9″ x 7/16″ 4 L s 2″ x 2″ x 7/16″ 2 Pl. 5¼″ x 7/16″ ⅞″ Rivets	7.88 6.24 4.59 18.71	2.34	120 85 50	23′4¹³⁄₁₆″ 16′6½₁₆″ 9′9 0″

General Notes:
Rivet Spacing = 4 diameters of rivet
End distance = 2 " " "
Make three columns of each length for all shapes

PROGRESS REPORT OF SPECIAL COMMITTEE ON BITUMINOUS MATERIALS FOR ROAD CONSTRUCTION.

To the American Society of Civil Engineers.

Gentlemen:—Your Special Committee on "Bituminous Materials for Road Construction" respectfully submits the following Progress Report:

Your Committee has especially considered during the past year the various methods of writing specifications covering the physical and chemical properties of bituminous materials for use in the construction of bituminous surfaces and bituminous pavements.

Many of these properties vary to a remarkable degree, dependent primarily upon the source of the material and the methods employed in refining. It is recognized that it is often essential to specify narrow limitations of certain properties in order to secure desired chemical and physical characteristics and uniformity in the manufactured material. It is not in many cases practicable to specify the same limitations, except for materials obtained from the same or similar sources and prepared in the same manner.

Therefore it is suggested that, for the present at least, whenever comprehensive specifications are to be prepared so as to admit a variety of types of materials, separate specifications as may be necessary be prepared for each type. As an illustration, the specification for the bituminous cement to be used in the construction of a bituminous pavement by the mixing method might contain independent specifications covering, within narrow limits, the physical and chemical properties of each of the following bituminous materials: refined water-gas tars, refined coal-gas tars, mixtures of tars, asphalts containing native bitumen from one or more sources, asphalts obtained by refining petroleum from one or more sources, and asphalts which are solid or semi-solid compounds composed of the bitumens mentioned with petroleums or derivatives thereof.

Your Committee, recognizing an unfortunate tendency to use as the generic expression the terms "bituminous material" and "bitumen" synonymously, recommends that the term "bituminous material" be used as a generic expression when referring to road and paving materials containing bitumen, and that the term "bitumen" be used in a restricted sense as covered by the following definition adopted by the American Society for Testing Materials:

"Bitumens are mixtures of native or pyrogenous hydrocarbons and their non-metallic derivatives, which may be gases, liquids, viscous liquids, or solids, and which are soluble in carbon disulphide."

An illustration of ambiguity in the use of the two terms may be found in some descriptions of bituminous pavements, where a bitu-

minous cement, only 75% soluble in carbon disulphide, was used. In the general description of these pavements, the word "bitumen" was used to refer to the material as a whole, while, in giving the analysis of the mix, the word "bitumen" was used to refer only to that portion of the cement soluble in carbon disulphide.

Your Committee, in its Report at the last Annual Meeting of the Society, recommended then that especial attention be directed during the year 1912 to the following points:

(*a*)—The maximum amount of distillate from tars coming over, up to 170° cent., that can satisfactorily be allowed;

(*b*)—The maximum percentage of free carbon that can be successfully allowed in a tar used for superficial treatment under varying climatic conditions;

(*c*)—The maximum amount of residue and the limitations of penetration thereof that can be satisfactorily permitted in an asphaltic oil used for superficial treatment.

Your Committee then recommended, also, that general consideration be given to

(*d*)—The use of a seal coat on bituminous pavements constructed by the mixing method; and

(*e*)—The establishment of standards for arriving at figures of cost on engineering work, especially road work.

Taking these points *seriatim*, your Committee, having given them especial attention during the past year, now agrees as follows:

(*a*)—The maximum amount of distillate, up to 170° cent., allowable in tars may depend upon the proportions of the other fractions in a tar, or upon the conditions of use of the tar, or upon the conditions on the road surface after its construction, or possibly upon some other factors. Although the Committee has endeavored to secure all possible information, it feels that certain important data are still lacking, and therefore deems it best to refrain now from stating what might seem to be too hasty conclusions in the matter.

(*b*)—Your Committee submits that considerable evidence seems to make undesirable in tars for superficial treatments the presence of free carbon beyond a maximum, dependent on the fraction distillable between 170 and 300° cent., in order at least to avoid brittleness at low temperatures.

(*c*)—Your Committee agrees that the maximum amount of residue allowable in an asphaltic oil used for superficial treatment should be as great as permitted by the physical conditions of its use, subject to certain limits in the penetration of this residue, and that such limits in penetration should be:

A minimum which will ensure against excessive hardness or slipperiness under travel, at low temperatures.

A maximum which will ensure against excessive softness or lack of body at the highest temperatures to be expected after use on the road.

(*d*)—Your Committee has, as it recommended last year, devoted considerable attention to the use of a seal coat on mixed bituminous pavements, but simply wishes at this time to recommend further investigation concerning the use of seal coats on all types of bituminous pavements.

(*e*)—Your Committee renews its recommendation of last year regarding the establishment of standards for the record and compilation of cost figures.

Your Committee also last year in its Report advocated the adoption of two expressions, *viz.*, "Bituminous Surfaces" and "Bituminous Pavements", to cover the ordinary uses of bituminous materials in road construction, and defined the application of each. It now wishes to report that these terms, as defined by the Committee, seem to have been widely adopted, with general benefit. Your Committee now further advocates the adoption of the following definition:

"Bituminous Concrete Pavements" are those composed of stone, gravel, sand, shell, or slag, or combinations thereof, and bituminous materials incorporated together by mixing methods.

Very respectfully,

W. W. CROSBY, *Chairman,*
HUBERT K. BISHOP,
ARTHUR W. DEAN,
ARTHUR H. BLANCHARD, *Secretary.*

ANNOUNCEMENTS

The House of the Society is open from 9 A. M. to 10 P. M., every day, except Sundays, Fourth of July, Thanksgiving Day, and Christmas Day.

FUTURE MEETINGS

March 5th, 1913.—8.30 P. M.—A regular business meeting will be held, and a paper by Caleb Mills Saville, M. Am. Soc. C. E., entitled "Hydrology of the Panama Canal," will be presented for discussion.

This paper was printed in *Proceedings* for January, 1913.

March 19th, 1913.—8.30 P. M.—At this meeting a paper by E. J. Schneider, M. Am. Soc. C. E., entitled "Construction Problems, Dumbarton Bridge, Central California Railway," will be presented for discussion.

This paper was printed in *Proceedings* for January, 1913.

April 2d, 1913.—8.30 P. M.—This will be a regular business meeting. Two papers will be presented for discussion, as follows: "Shearing Strength of Construction Joints in Stems of Reinforced Concrete T-Beams, as Shown by Tests," by Lewis J. Johnson, M. Am. Soc. C. E., and John R. Nichols, Jun. Am. Soc. C. E.; and "Fremantle Graving Dock: Steel Dam Construction for North Wall," by Joshua Fielden Ramsbotham, Assoc. M. Am. Soc. C. E.

These papers are printed in this number of *Proceedings*.

SEARCHES IN THE LIBRARY

In January, 1902, the Secretary was authorized to make searches in the Library, upon request, and to charge therefor the actual cost to the Society for the extra work required. Since that time many searches have been made, and bibliographies and other information on special subjects furnished.

The resulting satisfaction, to the members who have made use of the resources of the Society in this manner, has been expressed frequently, and leaves little doubt that, if it were generally known to the membership that such work would be undertaken, many would avail themselves of it.

The cost is trifling compared with the value of the time of an engineer who looks up such matters himself, and the work can be performed quite as well, and much more quickly, by persons familiar with the Library.

In asking that such work be undertaken, members should specify clearly the subject to be covered, and whether references to general books only are desired, or whether a complete bibliography, involving search through periodical literature, is desired.

In reference to this work, the Appendices* to the Annual Reports of the Board of Direction for the years ending December 31st, 1906, and December 31st, 1910, contain summaries of all searches made to date.

PAPERS AND DISCUSSIONS

Members and others who take part in the oral discussions of the papers presented are urged to revise their remarks promptly. Written communications from those who cannot attend the meetings should be sent in at the earliest possible date after the issue of a paper in *Proceedings.*

All papers accepted by the Publication Committee are classified by the Committee with respect to their availability for discussion at meetings.

Papers which, from their general nature, appear to be of a character suitable for oral discussion, will be published as heretofore in *Proceedings,* and set down for presentation to a future meeting of the Society, and, on these, oral discussions, as well as written communications, will be solicited.

All papers which do not come under this heading, that is to say, those which from their mathematical or technical nature, in the opinion of the Committee are not adapted to oral discussion, will not be scheduled for presentation to any meeting. Such papers will be published in *Proceedings* in the same manner as those which are to be presented at meetings, but written discussions, only, will be requested for subsequent publication in *Proceedings* and with the paper in the volumes of *Transactions.*

LOCAL ASSOCIATIONS OF MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

San Francisco Association

The San Francisco Association of Members of the American Society of Civil Engineers holds regular bi-monthly meetings, with banquet, and weekly informal luncheons. The former are held at 6 P. M., at the Palace Hotel on the third Friday of February, April, June, August, October, and December, the last being the Annual Meeting of the Association.

Informal luncheons are held at 12.15 P. M., every Wednesday, and the place of meeting may be ascertained by communicating with the Secretary of the Association, E. T. Thurston, Jr., M. Am. Soc. C. E., 713 Mechanics' Institute, 57 Post Street.

The by-laws of the Association provide for the extension of hospitality to any member of the Society who may be temporarily in San Francisco, and any such member will be gladly welcomed as a guest.

* *Proceedings*, Vol. XXXIII, p. [20] (January, 1907); Vol. XXXVII, p. 28 (January, 1911).

Colorado Association

The meetings of the Colorado Association of Members of the American Society of Civil Engineers are held on the second Saturday of each month, except July and August. The hour and place of meeting are not fixed, but this information will be furnished on application to the Secretary, Gavin N. Houston, M. Am. Soc. C. E., 409 Equitable Building, Denver, Colo. The meetings are usually preceded by an informal dinner. Members of the American Society of Civil Engineers will be welcomed at these meetings.

Weekly luncheons are held on Wednesdays, and, until further notice, will take place at the Colorado Traffic Club.

Visiting members are urged to attend the meetings and luncheons.

(Abstract of Minutes of Meetings)

December 14th, 1912.—The meeting was called to order; President Ketchum in the chair; G. N. Houston, Secretary; and present, also, 18 members and 5 guests.

A paper entitled "Proposed Legislation" was presented by C. W. Comstock, M. Am. Soc. C. E., after which Mr. E. F. Bohm, of the *Great West Magazine,* reviewed the irrigation situation in the West. A general discussion of the subject followed.

The proposed bill for licensing engineers in Colorado was discussed, and, on motion, was referred to the Committee which had it in charge during the past year, with instructions to introduce it again, without change, in the next Legislature. On request President Ketchum's place on the Committee was taken by Secretary Houston.

A general discussion followed, in which nearly all present took part.

Adjourned.

January 11th, 1913.—The meeting was called to order; President Ketchum in the chair; G. N. Houston, Secretary; and present, also, 16 members and 7 guests.

Messrs. G. G. Anderson, J. C. Ulrich, and H. S. Crocker were appointed an Auditing Committee.

Messrs. Anderson, Comstock, Field, Crocker, and Houston, were appointed a Committee on Legislation to look into proposed legislation affecting engineering practice in general, and make such suggestions as they deem proper.

A paper entitled "The Prewitt Irrigation Proposition" was presented by J. C. Ulrich, M. Am. Soc. C. E., who illustrated his remarks with lantern slides.

Adjourned.

Atlanta Association

On March 14th, 1912, the Atlanta Association of Members of the American Society of Civil Engineers was organized, with the following officers: Arthur Pew, President; William A. Hansell, Jr., Secretary; and Messrs. James N. Hazlehurst and Alexander Bonnyman, Members of the Executive Committee. The Association will hold its meetings in the house of the University Club.

PRIVILEGES OF ENGINEERING SOCIETIES EXTENDED TO MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Members of the American Society of Civil Engineers will be welcomed by the following Engineering Societies, both to the use of their Reading Rooms and at all meetings:

American Institute of Mining Engineers, 29 West Thirty-ninth Street, New York City.

American Society of Mechanical Engineers, 29 West Thirty-ninth Street, New York City.

Architekten-Verein zu Berlin, Wilhelmstrasse 92, Berlin W. 66, Germany.

Associação dos Engenheiros Civis Portuguezes, Lisbon, Portugal.

Australasian Institute of Mining Engineers, Melbourne, Victoria, Australia.

Boston Society of Civil Engineers, 715 Tremont Temple, Boston, Mass.

Brooklyn Engineers' Club, 117 Remsen Street, Brooklyn, N. Y.

Canadian Society of Civil Engineers, 413 Dorchester Street, West, Montreal, Que., Canada.

Civil Engineers' Society of St. Paul, St. Paul, Minn.

Cleveland Engineering Society, Chamber of Commerce Building, Cleveland, Ohio.

Cleveland Institute of Engineers, Middlesbrough, England.

Dansk Ingeniorforening, Amaliegade 38, Copenhagen, Denmark.

Engineers' and Architects' Club of Louisville, Ky., 303 Norton Building, Fourth and Jefferson Streets, Louisville, Ky.

Engineers' Club of Baltimore, Baltimore, Md.

Engineers' Club of Minneapolis, 17 South Sixth Street, Minneapolis, Minn.

Engineers' Club of Philadelphia, 1317 Spruce Street, Philadelphia, Pa.

Engineers' Club of St. Louis, 3817 Olive Street, St. Louis, Mo.

Engineers' Club of Toronto, 96 King Street, West, Toronto, Ont., Canada.

Engineers' Society of Northeastern Pennsylvania, 302 Board of Trade Building, Scranton, Pa.

Engineers' Society of Pennsylvania, 219 Market Street, Harrisburg, Pa.

Engineers' Society of Western Pennsylvania, 2511 Oliver Building, Pittsburgh, Pa.

Institute of Marine Engineers, 58 Romford Road, Stratford, London, E., England.

Institution of Engineers of the River Plate, Buenos Aires, Argentine Republic.

Institution of Naval Architects, 5 Adelphi Terrace, London, W. C., England.

Junior Institution of Engineers, 39 Victoria Street, Westminster, S. W., London, England.

Koninklijk Instituut van Ingenieurs, The Hague, The Netherlands.

Louisiana Engineering Society, 321 Hibernia Bank Building, New Orleans, La.

Memphis Engineering Society, Memphis, Tenn.

Midland Institute of Mining, Civil and Mechanical Engineers, Sheffield, England.

Montana Society of Engineers, Butte, Mont.

North of England Institute of Mining and Mechanical Engineers, Newcastle-upon-Tyne, England.

Oesterreichischer Ingenieur- und Architekten-Verein, Eschenbachgasse 9, Vienna, Austria.

Pacific Northwest Society of Engineers, 803 Central Building, Seattle, Wash.

Rochester Engineering Society, Rochester, N. Y.

Sachsischer Ingenieur- und Architekten-Verein, Dresden, Germany.

Sociedad Colombiana de Ingenieros, Bogota, Colombia.

Sociedad de Ingenieros del Peru, Lima, Peru.

Societe des Ingenieurs Civils de France, 19 Rue Blanche, Paris, France.

Society of Engineers, 17 Victoria Street, Westminster, S. W., London, England.

Svenska Teknologforeningen, Brunkebergstorg 18, Stockholm, Sweden.

Tekniske Forening, Vestre Boulevard 18–1, Copenhagen, Denmark.

Western Society of Engineers, 1737 Monadnock Block, Chicago, Ill.

ACCESSIONS TO THE LIBRARY

(From January 2d to February 1st, 1913)

DONATIONS*

THE ECONOMICS OF RAILROAD CONSTRUCTION.

By Walter Loring Webb, M. Am. Soc. C. E. Second Edition, Revised. Cloth, 8¼ x 5¼ in., illus., 10 + 347 pp. New York, John Wiley & Sons; London, Chapman & Hall, Limited, 1912. $2.50.

The first edition of this work was published in 1906. Since that time the Interstate Commerce Commission has made changes in the classification of operating expenses, which, it is stated, necessitated a practical rewriting of the chapters on that subject, as well as those on Distances, Curvature, and Grade. The changes in the first chapters consist principally of enlarging tables and diagrams and of bringing them up to date. As in the previous edition, this book is written, it is stated, from the standpoint of the constructing or operating engineer, railroad legislation and kindred subjects being considered only as they affect questions which must be answered by the railroad engineer, namely, legal methods of organization, railroad finance, etc. The Contents are: Part I, Financial and Legal Elements of the Problem: Railway Statistics; The Organization of Railroads; Capitalization; The Valuation of Railroad Property; Estimation of Volume of Traffic. Part II, Operating Elements of the Problem: Operating Expenses; Motive Power; Economics of Car Construction; Track Economics; Train Resistance; Momentum Grades. Part III, Physical Elements of the Question: Distance; Curvature; Minor Grades; Ruling Grades; Pusher Grades; Balancing Grades for Unequal Traffic; Index.

A HANDBOOK OF ENGLISH FOR ENGINEERS.

By Wilbur Owen Sypherd. Leather, 7 x 4¾ in., 314 pp. Chicago and New York, Scott, Foresman and Company, 1913. $1.50.

This book is designed primarily, it is stated, to provide a manual of technical English and composition for advanced engineering students and for young engineers in actual practice, together with specific instruction in the writing of business letters, reports, instructions, estimates, specifications, and contracts, and articles for technical journals. Chapter I is devoted to the specific discussion of the planning and presentation of technical papers, kinds of writing, language, form, etc., and, for the purposes of analysis and illustration, may be used in connection with Chapter V, which contains specimens of technical articles from various fields of engineering. In Chapter II are given rules for the use of abbreviations, hyphens, numbers, capital letters, etc., which are said to be in accord with the best practice in engineering writing. Business letters and reports are discussed in Chapter III, particular stress being laid, it is stated, on the writing of letters of application. In Chapter IV, the author discusses the various kinds of reports, and examples of reports on laboratory experiments, tests, progress work, inspection work, etc., are given. The Appendices contain directions for proof-reading, examples of faulty paragraphs and sentences, lists of words frequently misused and misspelled, and a bibliography of the subjects treated in the book. The Contents are: The General Problems of Engineering Writing; Mechanical Details Common to the Various Forms of Technical Writing; Business Letters; Reports; Articles for Technical Journals; Index.

AMERICAN CIVIL ENGINEERS' POCKET BOOK.

By Mansfield Merriman, M. Am. Soc. C. E., Editor-in-Chief; Messrs. Ira O. Baker, Arthur H. Blanchard, Charles B. Breed, Walter J. Douglas, Louis A. Fischer, George A. Goodenough, Allen Hazen, Frank P. McKibben, Edward R. Maurer, Rudolph P. Miller, Alfred Noble, Frederick E. Turneaure, Walter Loring Webb, Gardner S. Williams, Associate Editors. Second Edition, Enlarged. Leather, 7 x 4¼ in., illus., 8 + 1473 pp. New York, John Wiley & Sons; London, Chapman & Hall, Limited, 1912. $5.00.

In the preface to the first edition the fundamental principles observed in the preparation of this book are stated to have been: (1) The selection of topics to which engineers desire to refer; (2) The condensation of the matter so that the

*Unless otherwise specified, books in this list have been donated by the publishers.

greatest amount may be put in the assigned space and, at the same time, be clearly represented; (3) The fact that this pocket-book must be better and fuller than any hitherto published in the English language. The former arrangement of the subject-matter is followed in this edition. Two new sections have been added, as well as much new matter in the case of the other sections, and the editor hopes that, in its enlarged form, the book may advance sound engineering practice and assist the younger members of the Profession to a greater extent than before. The Contents are: Mathematical Tables, by Mansfield Merriman; Surveying, Geodesy, Railroad Location, by Charles B. Breed; Steam and Electric Railroads, by Walter Loring Webb; Materials of Construction, by Rudolph P. Miller; Plain and Reinforced Concrete, by Frederick E. Turneaure; Masonry, Foundations, Earthwork, by Ira O. Baker; Masonry and Timber Structures, by Walter J. Douglas; Steel Structures, by Frank P. McKibben; Hydraulics, Pumping, Water Power, by Gardner S. Williams; Water Supply, Sewerage, Irrigation, by Allen Hazen; Dams, Aqueducts, Canals, Shafts, Tunnels, by Alfred Noble and Silas H. Woodard; Mathematics and Mechanics, by Edward R. Maurer; Physics, Meteorology, Weights and Measures, by Louis A. Fischer; Steam and Electric Engineering, by George A. Goodenough and F. Malcolm Farmer; Highways and Streets, by Arthur H. Blanchard; Index, by Clinton L. Bogert.

EARTHWORK AND ITS COST.

By Halbert Powers Gillette, M. Am. Soc. C. E. Second Edition. With a Chapter on Ditching and Trenching Machinery, by E. E. R. Tratman, Assoc. M. Am. Soc. C. E. Cloth, 9½ x 6¼ in., illus., 11 + 238 pp. New York and London, McGraw-Hill Book Company, 1912. $2.00.

It is stated that it is only through a knowledge of cost details, such as are obtained from a study of tools and methods of construction, that an engineer can hope to design economic structures and predict the actual cost with accuracy, and the author's principal aim in this book has been, it is said, to formulate rules and lay down principles to be used by engineers and contractors in estimating such costs. The Chapter headings are: Introduction; Earth Shrinkage; Earth Classification and Factors in Estimating Earthwork; Cost of Loosening and Shoveling; Cost of Dumping, Spreading, Rolling, etc., Cost of Wheelbarrows and Carts; Cost by Wagons; Cost by Buck and Drag Scrapers; Cost by Wheel Scrapers; Cost by Elevating Grader; Cost by Steam Shovel; Cost by Cars; How to Handle a Steam Shovel Plant; Summary and Table of Costs; The Cost of Hydraulic Excavation; Cost of Dredging; Miscellaneous Cost Data; Earth and Earth Structures; Appendix A, Rapid Field and Office Survey Work; Appendix B, Overhaul Calculation; Appendix C, A Small "Home-Made" Dipper Dredge or Steam Shovel; Appendix D, Ditching and Trenching Machinery, by E. E. R. Tratman; Index.

RAILROAD CONSTRUCTION.

By Charles Lee Crandall, M. Am. Soc. C. E., and Fred Asa Barnes, Assoc. M. Am. Soc. C. E. Cloth, 9½ x 6¼ in., illus., 8 + 321 pp. New York and London, McGraw-Hill Book Company, 1913. $3.00.

The preface states that this book had its beginning in some notes on railroad construction which were issued in mimeograph form for the use of students in the College of Civil Engineering at Cornell University about twenty-five years ago. These notes have been frequently revised and brought up to date and are now presented in book form for general use. The subject-matter deals directly with construction work and includes descriptions of methods, materials, plant, costs, etc. At the end of each chapter references to books dealing with the subject discussed are given, which, it is hoped, will stimulate the student to do outside reading and aid the young engineer in obtaining special information as to handling work. The Chapter headings are: Introductory; Earthwork; Rock Excavation; Tunneling; Masonry; Foundations; Culvert and Bridge Masonry; Trestles and Bridges; Track Material and Roadbed; Estimates and Records; Index.

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BY PURCHASE

A Handbook of Sugar Analysis: A Practical and Descriptive Treatise for Use in Research, Technical and Control Laboratories. By C. A. Browne. John Wiley & Sons, New York; Chapman & Hall, Limited, London, 1912.

The Bacteriology of Surface Waters in the Tropics. By Wm. Wesley Clemesha. E. & F. N. Spon, Ltd., London; Thacker, Spink & Co., Calcutta, 1912.

Preliminary Studies in Bridge Designs, Being the First of a Series of Small Volumes, Each Complete in itself, Dealing with the Design of Ordinary Highway Bridges of Moderate Spans. By Reginald Ryves. The St. Bride's Press, Ltd., London.

Introduction to the Chemistry and Physics of Building Materials. By Alan E. Munby. Archibald Constable & Co., Ltd., London, 1909.

Analysis of Metallurgical and Engineering Materials: A Systematic Arrangement of Laboratory Methods. By Henry Wysor. The Chemical Publishing Co., Easton, Pa.; Williams & Norgate, London, 1912.

Railroads, Rates and Regulation. By William Z. Ripley. Longmans, Green and Co., New York and London, 1912.

A Dictionary of Applied Chemistry. By *Sir* Edward Thorpe, Assisted by Eminent Contributors. Vol. 3. Revised and Enlarged Edition. Longmans, Green and Co., New York and London, 1912.

The Prevention of Malaria. By Roland Ross and others. E. P. Dutton & Company, New York, 1910.

Steam Economy in the Sugar Factory. By Karl Abraham. Translated from the German Edition by E. J. Bayle. John Wiley & Sons, New York; Chapman & Hall, Limited, London, 1912.

Le Genie Civil: 2e Table Generale des Matieres; Tomes 21 a 40 (1892-1902). C. H. Talansier, Administrateur-Délégué du Génie Civil, Paris.

Mitteilungen über Forschungsarbeiten auf dem Gebiete des Ingenieurwesens insbesondere aus den Laboratorien der technischen Hochschulen. Herausgegeben vom Verein deutscher Ingenieure. Hefte 125-128. Julius Springer, Berlin, 1912.

Royal Commission on Sewage Disposal: Eighth Report of the Commissioners Appointed to Inquire and Report What Methods of Treating and Disposing of Sewage (Including any Liquid from any Factory or Manufacturing Process) May Properly be Adopted. Vol. 1, Report. Published by His Majesty's Stationery Office, London, 1912.

The World Almanac and Encyclopedia, 1913. The Press Publishing Co., New York.

A Manual of Machine Drawing and Design. By David Allan Low and Alfred William Bevis. New Edition, Revised and Enlarged. Longmans, Green and Co., New York and London, 1910.

Lieber's Standard Telegraphic Code. By B. Franklin Lieber. The Lieber Code Co., New York, 1896.

The A B C Universal Commercial Electric Telegraphic Code, Specially Adapted for the Use of Financiers, Merchants, Shipowners, Underwriters, Engineers, Brokers, Agents, etc. By W. Clausen-Thue. Fifth Edition. American Code Company, New York, 1901.

Brooklyn Daily Eagle Almanac, 1913: A Book of Information, General of the World, and Special of New York City and Long Island. Brooklyn Daily Eagle, Brooklyn, N. Y.

Notes on Hydraulics: A Pocket Book of Useful Data for Engineers, Architects, Factory Managers, Fire Insurance Inspectors, and Students. By Ira J. Owen. The Insurance Press, New York.

Water: Its Purification and Use in the Industries. By William Wallace Christie, M. Am. Soc. C. E. D. Van Nostrand Company, New York, 1912.

Gas Works Directory and Statistics, 1912-13, With a List of Chairmen, Managers, Engineers, and Secretaries and Lists of Associations of Engineers and Managers. Hazell, Watson and Viney, London, 1912.

Royal Commission on Canals and Waterways, Vol. 1-9, 11-12. Printed for His Majesty's Stationery Office, Wyman & Sons, Ltd., London, 1906-11.

SUMMARY OF ACCESSIONS

(From January 2d to February 1st, 1913)

Donations (including 41 duplicates)	317
By purchase	34
Total	351

MEMBERSHIP

ADDITIONS

(From January 3d to February 6th, 1913)

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CARUTHERS, WILLIAM STODDERT. Div. Engr., California Highway Comm., 1416 O St., Sacramento, Cal		Jan. 7, 1913
CONWAY, JOHN SEBASTIAN. Deputy Commr. of Lighthouses, Washington, D. C	Assoc. M.	May 4, 1909
	M.	Jan. 7, 1913
DONLEY, WILLIAM MCCLURG. Borough Engr., Boroughs of Carrick, Mt. Oliver, St. Clair, and Knoxville, Mt. Oliver P. O. Station, Pittsburgh, Pa		Jan. 7, 1913
DOTY, JOHN WILLIAMS. With The Foundation Co., 115 Broadway, New York City	Jun.	Nov. 3, 1903
	Assoc. M.	Jan. 4, 1905
	M.	Jan. 7, 1913
FISHER, HOWELL TRACY. Tunnel Engr., Mackenzie, Mann & Co., Ltd., 411 Dorchester St., West, Montreal, Que., Canada	Assoc. M.	Nov. 1, 1905
	M.	Jan. 7, 1913
HAMMER, JOHANNES MARCELIUS. Asst. Engr., Isthmian Canal Comm., 5712 Forbes St., Pittsburgh, Pa		Jan. 7, 1913
HANNA, FRANK WILLARD. Engr., U. S. Reclamation Service, Washington, D. C		Jan. 7, 1913
HATT, WILLIAM KENDRICK. Prof. of Civ. Eng., and Director, Testing Labaratory, Purdue Univ., Lafayette, Ind	Assoc. M.	June 4, 1902
	M.	Jan. 7, 1913
HUNICKE, WILLIAM AUGUST. Chf. Engr., Louisiana & Northwest Ry., Homer, La.	Assoc. M.	Mar. 2, 1904
	M.	Jan. 7, 1913
LAIRD, HARRY SNEDDEN. Res. Engr., Am. Water-Works & Guarantee Co., Hydro-Elec. Dept., Cheat Haven, Pa		Dec. 3, 1912
MACCORNACK, CLYDE WEBSTER. Asst. Chf. Engr., Phœnix Bridge Co., 324 Gay St., Phœnixville, Pa	Jun.	Jan. 31, 1905
	Assoc. M.	Dec. 1, 1908
	M.	Jan. 7, 1913
NEWMAN, JEROME. Chf. Engr., Board of State Harbor Commrs., 18 Ferry Bldg., San Francisco, Cal		Jan. 7, 1913
ROBINSON, HOLTON DUNCAN. Cons. Engr., 357 West 121st St., New York City	Jun.	Mar. 1, 1893
	Assoc. M.	Jan. 3, 1894
	M.	Jan. 7, 1913
YATES, WILLIAM HENRY. Superv. Engr., N. Y. State Barge Canal, Barge Canal Office, Albany, N. Y.	Jun.	Feb. 2, 1904
	Assoc. M.	Jan. 8, 1908
	M.	Jan. 7, 1913

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	Assoc. M.	Jan. 7, 1913

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BROWN, AMON BENJAMIN. Asst. Engr., U. S. Reclamation Service, Rupert, Idaho		Jan. 7, 1913
BROWN, LEVANT R. Asst. Engr., Bureau of Public Works, Manila, Philippine Islands		Jan. 7, 1913
BURROUGHS, FREDRIC SIDNEY. Asst. Engr., Public Service Comm. of Washington, Olympia, Wash		Dec. 3, 1912
BURTON, WAYNE JOSEPH. Designing Engr., Office of Chf. Engr., M. of W., Mo. Pac. Ry., 627 Midland Bldg., Kansas City, Mo	Jun.	Sept. 4, 1906
	Assoc. M.	Jan. 7, 1913
CAMERON, KENNETH MACKENZIE. Prin. Asst. to Asst. Chf. Engr., Dept of Public Works, 132 Flora St., Ottawa, Ont., Canada	Jun.	Oct. 6, 1903
	Assoc. M.	Oct. 1, 1912
COMBER, STAFFORD XAVIER. Underpinning & Foundation Co., 290 Broadway, New York City		Jan. 7, 1913
CROCKER, FOSTER BALDWIN. Barge Canal Office, R. F. D. No. 5, Rome, N. Y.	Jun.	June 30, 1911
	Assoc. M.	Jan. 7, 1913
DEUTSCHBEIN, HARRY JOHNSON. Asst. Supt., The Foundation Co., Little Hocking, Ohio	Jun.	Dec. 6, 1904
	Assoc. M.	Jan. 7, 1913
DIBBLE, BARRY. Electrical Engr., U. S. Reclamation Service, Minidoka, Idaho		Dec. 3, 1912
DORON, CHARLES SLAUTER. Engr. in Chg., Dept. of Parks, Brooklyn, N. Y.		Jan. 7, 1913
DRIGGS, EDWIN LEROY. Asst. Engr., Bureau of Public Works, Manila, Philippine Islands	Jun.	Nov. 5, 1907
	Assoc. M.	Oct. 29, 1912
FITZSIMONS, WAVELAND SINCLAIR. Junior Engr., U. S. Engr. Office, Georgetown, S. C		Oct. 29, 1912
GILLELEN, FRANK. (Olmsted & Gillelen), 604 Wright & Callender Bldg., Los Angeles, Cal.	Jun.	May 1, 1906
	Assoc. M.	Feb. 4, 1913
GIQUEL, RAFAEL SANCHEZ. First Engr. in Chg. of Design of Aqueducts for Province of Havana, Calle A, No. 172, Vedado, Havana, Cuba	Jun.	Feb. 4, 1908
	Assoc. M.	Dec. 3, 1912
GREGG, JOHN HUSTON CLARK. Asst. Engr., Carpenter & Boxley & Herrick, Inc., 6720 Ridge Boulevard, Brooklyn, N. Y.		Jan. 7, 1913
HALL, JULIUS REED. Designing Engr., Strauss Bascule Bridge Co., 608 Monroe Bldg., Chicago, Ill.	Jun.	June 6, 1905
	Assoc. M.	Dec. 3, 1912

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HASELTON, GAGE. 247 Stout St., Portland, Ore.	Jun.	May 3, 1904
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KIRKPATRICK, RALPH ZENAS. Junior Engr., care, Chf. Engr.'s Office, Isthmian Canal Comm., Pedro Miguel, Canal Zone, Panama.		Dec. 3, 1912
KORSMO, AMUND MARIUS. Asst. Engr., The Faris Eng. & Constr. Co., Oakley, Idaho.		Jan. 7, 1913
LEACH, THOMAS. Designer, Dominion Bridge Co., Ltd., Montreal, Que., Canada.	Jun.	June 30, 1910
	Assoc. M.	Dec. 3, 1912
LINDSAY, RICHARD LEE. 502 Fourteenth Ave., Roanoke, Va.	Jun.	Sept. 4, 1906
	Assoc. M.	Sept. 3, 1912
MACLEAN, WILLIAM EUSTACE. Care, City Clerk, Salmon Arm, B. C., Canada.		Jan. 7, 1913
MCKINNEY, FRANCIS WILLIAM. Asst. Engr., Baltimore Sewerage Comm., American Bldg., Baltimore, Md.	Jun.	Mar. 31, 1908
	Assoc. M.	Jan. 7, 1913
MOSS, WILLIAM BENJAMIN. Junior Engr., U. S. Engr. Dept. at Large, Room 807, Army Bldg., New York City (Res., 36 Pommer Ave., Tompkinsville, N. Y).		Jan. 7, 1913
MUMM, HANS, JR. County Engr., Snohomish County (Res., 2216 Hoyt Ave.), Everett, Wash.		July 9, 1912
MURPHY, JAMES FRANCIS. 165 Remsen St., Brooklyn, N. Y.	Jun.	May 31, 1910
	Assoc. M.	Sept. 3, 1912
PHELPS, HOWARD EASTWOOD. City Engr. and Bldg. Insp., Boulder, Colo.		Jan. 7, 1913
RENNER, CHARLES JOSEPH. City Engr. and Supt., Water, Streets, and Sewers, St. Albans, Vt.		Dec. 3, 1912
SMITH, PLUMER HENRY. Chf. Engr., Texas City Terminal Co., Texas City, Tex.		Jan. 7, 1913
STANAGE, JOHN LYNCH. Prin. Asst. Engr., Board of Engrs., Fort Worth Water Supply, Fort Worth, Tex.		Jan. 7, 1913
VAN SCOYOC, HARRY STEWART. Insp. Engr., Canada Cement Co., Ltd., Herald Bldg., Montreal, Que., Canada.		Jan. 7, 1913
WATTERS, VERNON GREGG. Chf. Engr., Live Oak, Perry & Gulf R. R., Live Oak, Fla.		Jan. 7, 1913
WILLIS, ALBERT JONES. Instr. in Civ. Eng., Cooper Union (Res., 1019 Trinity Ave.), New York City	Jun.	June 4, 1907
	Assoc. M.	Dec. 3, 1912

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DAVIS, FREDERICK CALVIN. Mgr., Pacific Clay Products Publicity Bureau, 515 Buena Vista Ave., San Francisco, Cal.	Jan. 7, 1913

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ARNOLT, FRITZ MUSS. New York Univ., University Heights, New York City	Dec. 3, 1912
BAILEY, PAUL. Res. Engr., Haviland & Tibbetts, 515 Ninth St., Sacramento, Cal	Jan. 7, 1913
BAKER, ALBERT ASA. Civ. Engr., U. S. N., Navy Yard, Brooklyn, N. Y	Oct. 29, 1912
BURR, GEORGE LINDSLEY. 416 High St., Keokuk, Iowa	Jan. 7, 1913
DE JONGH, ARTHUR FRANCIS. Banes, Oriente, Cuba	Dec. 3, 1912
EASON, FRANK GARY. U. S. Drainage Engr., Drainage Investigations, U. S. Dept. of Agri., Washington, D. C	July 9, 1912
JONES, PAUL SIDNEY. Asst. Engr., Co-operative Irrig. Investigations, Colo. Agri. Experiment Station and U. S. Dept. of Agri., Fort Collins, Colo	Dec. 3, 1912
LECKLITER, WALTER HARLAN. Corning, Iowa	Oct. 1, 1912
MCMILLAN, WILLIAM BRUCE. 411 South 11th St., San José, Cal	Jan. 7, 1913
PARKER, HENRY BRACKETTE. Leveler, N. Y. State Highway Dept., 259 Hamilton St., Albany, N. Y	Jan. 7, 1913
PORZELIUS, ALBERT FREDRICK. Asst. Engr., Arkansas Water Co., Little Rock, Ark	Jan. 7, 1913
SEAMAN, DANIEL HENRY. Estimator and Designer, Hay Foundry & Iron Works, 774 South 19th St., Newark, N. J	Dec. 3, 1912
SMITH, WALTER MICKLE, JR. Estimator and Computer, Noble & Woodard, 7 East 42d St., New York City	Jan. 7, 1913
STARKWEATHER, ALFRED KENNETH. Instrumentman with Passaic Val. Sewerage Comm., 30 Oakland Ave., Bloomfield, N. J	Jan. 7, 1913
WRIGHT, FREDERICK JOHN. First Asst. Engr. to County Engr. of Passaic County, 410 Van Houten St., Paterson, N. J	Jan. 7, 1913
YOUMANS, GEORGE LELAND. Res. Engr., G. N. Ry., Winesap, Wash	Jan. 7, 1913

REINSTATEMENTS

MEMBERS

	Date of Reinstatement.
QUINBY, EDWIN RUFUS	Jan. 15, 1913

RESIGNATIONS

ASSOCIATE MEMBERS	Date of Resignation.
HARRINGTON, FRANCIS BURCHARD	Jan. 7, 1913
SCOTT, JOHN KUHN	Jan. 7, 1913

JUNIORS

REESE, GEORGE WASHINGTON	Jan. 7, 1913
WARNER, GLENN	Jan. 7, 1913

DEATHS

ATTERBURY, CHARLES DE LA PLANE. Elected Associate Member Nov. 8th, 1909; died June 3d, 1912.

GRAY, GEORGE EDWARD. Elected Member July 2d, 1873; Honorary Member June 5th, 1894; died January 1st, 1913.

HAMILTON, WILLIAM GASTON. Elected Member October 7th, 1868; died January 23d, 1913.

MACGREGOR, JOHN. Elected Associate June 2d, 1903; died January 21st, 1913.

WATSON, JAMES. Elected Fellow December 5th, 1872; died December, 1910.

WHEELER, EBENEZER SMITH. Elected Member November 7th, 1883; died January 5th, 1913.

Total Membership of the Society, February 6th, 1913, 6 797.

MONTHLY LIST OF RECENT ENGINEERING ARTICLES OF INTEREST

(January 2d to February 1st, 1913)

NOTE.—*This list is published for the purpose of placing before the members of this Society, the titles of current engineering articles, which can be referred to in any available engineering library, or can be procured by addressing the publication directly, the address and price being given wherever possible.*

LIST OF PUBLICATIONS

In the subjoined list of articles, references are given by the number prefixed to each journal in this list:

(1) *Journal*, Assoc. Eng. Soc., Boston, Mass., 30c.
(2) *Proceedings*, Engrs. Club of Phila., Philadelphia, Pa.
(3) *Journal*, Franklin Inst., Philadelphia, Pa., 50c.
(4) *Journal*, Western Soc. of Engrs., Chicago, Ill., 50c.
(5) *Transactions*, Can. Soc. C. E., Montreal, Que., Canada.
(6) *School of Mines Quarterly*, Columbia Univ., New York City, 50c.
(7) *Gesundheits Ingenieur*, München, Germany.
(8) *Stevens Institute Indicator*, Hoboken, N. J., 50c.
(9) *Engineering Magazine*, New York City, 25c.
(10) *Cassier's Magazine*, New York City, 25c.
(11) *Engineering* (London), W. H. Wiley, New York City, 25c.
(12) *The Engineer* (London), International News Co., New York City, 35c.
(13) *Engineering News*, New York City, 15c.
(14) *Engineering Record*, New York City, 10c.
(15) *Railway Age Gazette*, New York City, 15c.
(16) *Engineering and Mining Journal*, New York City, 15c.
(17) *Electric Railway Journal*, New York City, 10c.
(18) *Railway and Engineering Review*, Chicago, Ill., 15c.
(19) *Scientific American Supplement*, New York City, 10c.
(20) *Iron Age*, New York City, 20c.
(21) *Railway Engineer*, London, England, 1s. 2d.
(22) *Iron and Coal Trades Review*, London, England, 6d.
(23) *Bulletin*, American Iron and Steel Assoc., Philadelphia, Pa.
(24) *American Gas Light Journal*, New York City, 10c.
(25) *American Engineer*, New York City, 20c.
(26) *Electrical Review*, London, England, 4d.
(27) *Electrical World*, New York City, 10c.
(28) *Journal*, New England Water-Works Assoc., Boston, Mass., $1.
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(30) *Annales des Travaux Publics de Belgique*, Brussels, Belgium, 4 fr.
(31) *Annales* de l'Assoc. des Ing. Sortis des Ecoles Spéciales de Gand, Brussels, Belgium, 4 fr.
(32) *Mémoires et Compte Rendu des Travaux*, Soc. Ing. Civ. de France, Paris, France.
(33) *Le Génie Civil*, Paris, France, 1 fr.
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(39) *Technisches Gemeindeblatt*, Berlin, Germany, 0,70m.
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(42) *Proceedings*, Am. Inst. Elec. Engrs., New York City, $1.
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(45) *Mines and Minerals*, Scranton, Pa., 25c.
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(50) *Stahl und Eisen*, Düsseldorf, Germany.
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(60) *Municipal Engineering*, Indianapolis, Ind., 25c.
(61) *Proceedings*, Western Railway Club, 225 Dearborn St., Chicago, Ill., 25c.
(62) *Industrial World*, 59 Ninth St., Pittsburgh, Pa., 10c.
(63) *Minutes of Proceedings*, Inst. C. E., London, England.
(64) *Power*, New York City, 5c.
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(89) *Proceedings*, Am. Soc. for Testing Materials, Philadelphia, Pa., $5.
(90) *Transactions*, Inst. of Naval Archts., London, England.
(91) *Transactions*, Soc. Naval Archts. and Marine Engrs., New York City.
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(94) *The Boiler Maker*, New York City, 10c.
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(102) *Organ für die Fortschritte des Eisenbahnwesens*, Wiesbaden, Germany.
(103) *Mining and Scientific Press*, San Francisco, Cal., 10c.
(104) *The Surveyor and Municipal and County Engineer*, London, England, 6d.
(105) *Metallurgical and Chemical Engineering*, New York City, 25c.
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Presses à Agglomérer les Charbons, pour la Fabrication des Boulets Ovoïdes. Dupuy frères et Cie. (34) Jan.
Monorail Electrique, Système Abel Pifre, Employé pour la Construction du Grand Collecteur de Nantes.* (34) Jan.
Benzolgewinnung aus Koksofengasen.* W. Friz-Zabrze. (52) Nov. 15.
Die Versuchsanlage für den Wettbewerb um den Kaiserpreis für den besten deutschen Flugzeugmotor.* F. Bendemann. (48) Nov. 16.
Darstellung der Betriebsvorgänge bei Kreiselpumpen.* H. A. Janssen. (48) Nov. 23.
Die Fräsmaschinen der Werkzeugmaschinenfabrik und Eisengiesserei von Droop & Rein in Bielefeld.* F. Nickel. (48) Dec. 7.
Vergleichende Untersuchungen an Wasserstrahl-Luftpumpen.* Grunewald. (48) Serial beginning Dec. 7.
Die spezifische Wärme und das spezifische Volumen des Wasserdampfes für Drücke bis 20 at und Temperaturen bis 550° C.* Max Jakob. (48) Dec. 7.
Kräfteverteilung und Greifen bei Selbstgreifen.* Pfahl. (48) Serial beginning Dec. 14.
Kabelkrane für Bauzwecke.* (40) Dec. 21.
Eine selbsttätige Anlage zur Aufbereitung von Formsand.* G. Geiger. (50) Dec. 26.
Die Wasserstation mit Benoidgasanlage in Pörsten.* Glinski. (102) Jan. 1.
Ueber Umkehrstrassenantriebe.* Georg Meyer. (50) Jan. 2.
National-Kessel für grosse Anlagen.* (7) Jan. 4.
Schüttfeuerungen für Braunkohlen. M. Grellert. (7) Jan. 4.
Ueber die Abhitzeverwertung bei Siemens-Martin-Oefen.* J. Schreiber. (50) Serial beginning Jan. 9.

Metallurgical.

The Fried. Krupp Steel Works, Annen.* (11) Dec. 27.
Investigation of the Iron Melting Problem.* A. W. Belden. (Paper read before the Am. Foundrymen's Assoc.) (47) Dec. 27.
Metallurgy at Tonopah.* M. W. von Bernewitz. (103) Dec. 28.
Progress in Gold-Silver Ore Treatment during 1912.* Alfred James. (103) Dec. 28.
The Electric Furnace in the Production of Iron from Ore.* D. A. Lyon. (105) Jan.
Cyaniding Slimy Ore by Continuous Decantation.* H. C. Parmelee. (105) Jan.
Some Present Pickling Methods. Oliver W. Storey. (105) Jan.
Mammoth System of Fume Control.* Al. H. Martin. (45) Jan.
Progress in the Metallurgy of Iron and Steel. Bradley Stoughton. (20) Jan. 2; (16) Jan. 11.
The Jones & Laughlin Aliquippa Works.* (20) Jan. 2.
Zinc Production and Smelting in 1912. R. G. Hall. (103) Jan. 4.
Progress of Copper Metallurgy.* Thomas T. Read. (103) Jan. 4.

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Cyaniding at the Wasp No. 2 Mill, Black Hills.* Jesse Simmons. (82) Jan. 4.
Progress in Ore Dressing. Henry S. Munroe. (103) Serial beginning Jan. 4.
Copper Alloys for Motor-Car Service. W. H. Barr. (Abstract of paper read before the Soc. of Automobile Engrs.) (47) Jan. 10.
The Metallurgy of Zinc. W. R. Ingalls. (16) Jan. 11.
Analysis of Cyanide Practice. Herbert A. Megraw. (16) Jan. 11.
Electric Arc Welding on the Pacific Coast.* (17) Jan. 11.
The Theoretical Effect of Increasing the Oxygen of the Blast Supplied to Blast Furnaces. Charles A. Edwards. (Paper read before the Cleveland Institution of Engrs.) (22) Jan. 17.
The Skoda Steel Works, Pilsen, Bohemia.* (12) Jan. 17.
Metallurgy of the Homestake Ore.* (16) Serial beginning Jan. 18.
The New No. 3 Mill at Flat River, Missouri.* S. R. Stone. (82) Jan. 18.
Lead Plant of the International Smelter.* L. S. Austin. (103) Jan. 18.
New Blast Furnace of Maryland Steel Company.* (20) Jan. 23.
Crystalline Growth of Strained Ferrite.* Albert Sauveur. (Paper read before the Inter. Congress for Testing Materials.) (20) Jan. 23.
The Igneous Concentration of Zinc Ores.* F. L. Clerc. (16) Jan. 25.
Electrolysis of Low Grade Gold Bullion. Theodore W. Bouchelle. (16) Jan. 25.
Treatment of Concentrate at the Goldfield Consolidated Mill. J. W. Hutchinson. (103) Serial beginning Jan. 25.
The MacNamara Mill, Tonopah.* M. W. von Bernewitz. (103) Jan. 25.
Smelting Iron by Electricity on the Pacific Coast.* (62) Jan. 27.
Studien über die im Hochofen zwischen den Eisenerzen und Gasen obwaltenden Verhältnisse.* Norbert Metz. (50) Jan. 16.

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Notes on Search-Light Mirrors at the Engineer School.* William F. Endress. (100) Jan.
The Adoption of an Automatic Gun. V. Lelen. (44) Serial beginning Jan.
Military Aviation and Aeronautics. B. D. Foulois. (44) Jan.
Progress in Military Explosives.* Wilford J. Hawkins. (13) Jan. 2.
The Modern Automobile Torpedo.* Robert G. Skerrett. (46) Jan. 4.
New Hangars for Military Uses.* (46) Jan. 18.
La Construction et la Pose des Mines Sous-Marines Système Elia.* (33) Jan. 4.

Mining.

A Plea for the Use of High Tension Constant Continuous Currents in Mines. Sydney F. Walker. (26) Dec. 27.
Electrical Symbols for Mine Maps.* H. H. Clark. (From *Technical Paper 22*, U. S. Bureau of Mines.) (57) Dec. 27.
Graphic Representation of Oilfield Structure.* Alexander J. Heindl. (103) Dec. 28.
Rock House of Quincy Mining Co.* T. C. Desoller. (Paper read before the Lake Superior Min. Inst.) (45) Jan.
Phosphate Ore Dressing.* Strauss L. Lloyd. (45) Jan.
Lake Superior and Cuban Iron Ores.* Day Allen Willey. (45) Jan.
Washery at Soddy Mine, Tennessee.* Frank E. Mueller. (45) Jan.
Mining Steep Dipping Coal.* A. A. Steel. (45) Jan.
Robbing Coal Dust of Its Dangers. Sim Reynolds. (45) Jan.
Coal Mining in India.* J. R. R. Wilson. (Paper read before the National Assoc. of Colliery Mgrs.) (22) Serial beginning Jan. 3.
Coal Washing Plant at a Colliery.* (12) Jan. 3.
Quicksilver Production and Prices.* Clifford G. Dennis. (103) Jan. 4.
Review of Gold-Dredging in 1912.* Charles Janin. (103) Jan. 4.
Mining at the Wasp No. 2, in the Black Hills, South Dakota.* Jesse Simmons. (16) Jan. 4.
Hoisting Practice in the Wisconsin Zinc Fields. W. F. Boericke. (16) Jan. 4.
Electric Power in the Kern and Midway Oil Fields.* Warren Aikens. (82) Jan. 11.
Notes on Diamond Drilling in the Porcupine District, Ont. Albert E. Hall. (From *School of Mines Quarterly.*) (82) Jan. 11.
Difficulties of Pumping on the Comstock Lode. Whitman Symmes. (Abstract of paper read before the California Miners' Assoc.) (82) Jan. 11.
Operations of the Davidson Ore Mining Co., Mich.* Geo. E. Edwards. (82) Jan. 11.
Winding Engine Controllers.* James Black. (Paper read before the National Assoc. of Colliery Mgrs.) (22) Jan. 17.
Shaft-Sinking for the Rondout Siphon.* J. F. Springer. (From *Western Engineering.*) (103) Jan. 18.
Filling of Mine Stopes with Mill Tailings. W. H. Storms. (Paper read before the California Miners' Assoc.) (82) Jan. 18.
Cobalt in 1912. Joseph T. Mandy. (68) Jan. 18.

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Method and Cost of Constructing a Concrete Lined Shaft by Sinking Through Overburden and Enlarging a Drift Raised Through Ledge Rock.* (86) Jan. 22.
Mining on the West Coast of South America.* Howland Bancroft. (103) Jan. 25.
South Africa. (Mining). Rowland Gascoyne. (82) Jan. 25.
Canada; British Columbia. (Mining). E. Jacobs. (82) Jan. 25.
Installing a Mining Plant in Latin America.* Edward W. Perry. (9) Feb.
Lining a Deep Shaft with Concrete. (14) Feb. 1.
Construction of No. 3 Shaft, Negaunee Mine.* S. R. Elliott. (16) Feb. 1.

Miscellaneous.

Brief Review of Engineering Practice and Personal Experience in Latin America Thirty-Two Years, 1880-1912. Elmer L. Corthell. (4) Dec.
The Electrical Measurement of Wind Velocity.* J. T. Morris. (Paper read before the British Assoc.) (11) Dec. 27.
The Present Opportunities and Consequent Responsibilities of the Engineer. Alexander C. Humphreys. (8) Jan.
Illumination of Interiors.* Preston S. Millar. (Paper read before the National Elec. Light Assoc. and the Illuminating Eng. Soc.) (83) Jan. 1.
Snow Slide Protection at Marble, Colorado.* Homer V. Knouse. (14) Jan. 18.
The Organization of a Corps of Civil Engineers for Public Works Services in the Dominion of Canada. (96) Jan. 23.
Extinguishing Fires with Sawdust. Edwin A. Barrier. (13) Jan. 30.

Municipal.

New Methods of Approaching the Smoke Problem. Osborn Monnelt. (4) Dec.
Delhi, the Metropolis of India.* *Sir* Bradford Leslie. (29) Dec. 27.
Grade and Surface Required on Roads.* (60) Jan.
The Minneapolis Park System.* (60) Jan.
The Kansas City Park System.* James H. Lowry (60) Jan.
Creosoted Block Paving in Chicago.* John Ericson. (60) Jan.
Specifications for Roads of Different Types. E. A. James. (96) Jan. 2.
History of Fifth Avenue Asphalt Pavement, New York. Clifford Richardson, M. Am. Soc. C. E. (14) Jan. 4.
Supplementary Reports on the 1907, 1908, 1909 and 1910 Dust Prevention and Road Preservation Experimental Work of the U. S. Office of Public Roads. (86) Jan. 8.
Methods of Preparing Cement Concrete Pavements. Frank F. Rogers. (Abstract of paper read before the Am. Assoc. for the Advancement of Science.) (86) Jan. 8.
Cost of Object Lesson Sand-Clay Roads Constructed in 1911-12 by the U. S. Office of Public Roads. Logan Waller Page. (86) Jan. 8.
A Method of Preparing Plans and Cross-Sections for Road Grading. (86) Jan. 8.
Distillation of Tar: Methods of Determination and Value in Specifications. Philip P. Sharples. (Paper read before the Am. Assoc. for the Advancement of Science.) (86) Jan. 8.
Reinforced Concrete Elevated Sidewalks, East St. Louis, Ill.* E. R. Rodenberg. (13) Jan. 9.
Why Smoke is an Industrial Nuisance.* R. C. Benner. (20) Jan. 9.
The Laying Out of Public Parks.* Thomas Mawson. (Report to the Preston Corporation.) (104) Jan. 10.
Europe's Good Roads.* Francis Miltoun. (46) Jan. 11.
Oil-Cement Concrete and Bituminous Concrete in Experimental Pavements on Hillside Avenue, Queens Borough, New York City. (From *Circular*, U. S. Office of Public Roads.) (86) Jan. 15.
Experimental Reinforced Concrete Pavement at Riverbank, Cal. (86) Jan. 15.
The Road Question in Manitoba. A. McGillivray. (Paper read before the Union of Manitoba Municipalities.) (96) Jan. 16.
Method of Determining the Toughness of Bituminous Materials. J. E. Myers. (Abstract of paper read before the Am. Assoc. for the Advancement of Science.) (14) Jan. 18.
The Traffic Census as a Preliminary to Road Improvement. William D. Sohier. (Abstract of paper read before the Am. Good Roads Congress.) (86) Jan. 22.
The Value of the Traffic Census in the Economical Design of Highways. Arthur H. Blanchard. (Paper read before the Am. Good Roads Congress.) (86) Jan. 22.
King Edward VII Highway. H. S. Van Scoyoc, Assoc. M. Am. Soc. C. E. (96) Jan. 23.
Maintenance and Repair of Asphalt, Bitulithic and Creosoted Wood Block Pavements. W. L. Hempelmann. (Paper read before the Illinois Soc. of Engrs. and Surveyors.) (86) Jan. 29.
Experimental Road Construction at Chevy Chase, Md., by the U. S. Office of Public Roads. (86) Jan. 29.

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Method of Laying Wood Block Pavement. H. S. Loud. (Paper read before the Am. Wood Preservers' Assoc.) (86) Jan. 29; (96) Jan. 30.
Timber for Creosoted Block Paving. Harry C. Davis. (Paper read before the Am. Wood Preservers' Assoc.) (96) Jan. 30.
Methods of Repairing Cement-Concrete Pavements. (14) Feb. 1.
Bituminous Gravel Concrete Pavement. Spencer J. Stewart. (Abstract of paper read before the Am. Assoc. for the Advancement of Science.) (14) Feb. 1.
Suitable Foundations for Brick Pavements. Robert Hoffman. (Abstract of paper read before the Am. Assoc. for the Advancement of Science). (14) Feb. 1.
Teer als Baumaterial für Stadtstrassen. F. Raschig. (39) Dec. 20.
Radrennbahn aus Eisenbeton in Zürich.* Jaro Polivka. (78) Jan. 3.

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Some Features of the West African Government Railways.* Frederic Shelford. (63) Vol. 189.
Specifications. (For Railroads.) O. S. Beyer, Jr. (61) Dec. 17.
Locomotive Power on Narrow Gauge Railways.* (12) Dec. 27.
The Florian Angele Valve Gear.* (For Locomotives.) (12) Dec. 27.
Large Boilers for New Baldwin Locomotives.* (94) Jan.
Flash Signalling in British Railway Practice.* J. F. Gairns. (88) Jan.
Tests Relating to the Pulling Out of Stays and the Deformation of the Flat Walls of Fire-Boxes. M. U. Gololobov. (88) Jan.
American and European Locomotive Efficiency.* (21) Jan.
A. G. A. Flashlights Signals on the Swedish State Railways. (21) Jan.; (12) Jan. 10.
Calling-on Arms: Metropolitan District Railway.* (21) Jan.
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New Long Non-Stop Express Trains in Bavaria.* (21) Jan.
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Steel End for Box Cars.* (15) Jan. 10; (25) Jan.
Enlarging the Galesburg Tie Plank.* (87) Jan.
Panama R. R. Relocation.* F. Mears. (From Annual Report of the Isthmian Canal Comm.) (87) Jan.
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Locomotives for the Associated Lines.* (25) Jan.
Slater Front End.* (For Locomotives.) (25) Jan.
Locomotive Boiler Tube Tools.* Walter R. Hedeman. (25) Jan.
La Salle Street Tunnel Under Chicago River.* (67) Jan.
Reinforced Concrete Culvert Pipe. (From Report of the Am. Ry. Bridge and Building Assoc.) (67) Jan.
Gravel Washing Plant of the Richmond, Fredericksburg & Potomac and Washington Southern.* S. B. Rice. (67) Jan.
A Train-Order Signal Controlled by the Train Dispatcher.* (13) Jan. 2.
Steam Action in Locomotive Cylinders.* Lawford H. Fry. (11) Serial beginning Jan. 3.
The French Yunnan Railway.* (11) Jan. 3.
Impressions of German Railway Practice. Henry W. Jacobs. (15) Jan. 3.
Steam Road Electrifications. A. H. Armstrong. (17) Jan. 4.
The Development of the Electric Railway Motor. N. W. Storer. (17) Jan. 4.
Progress in Electric Power Transmission Practice. (For Railways.) Louis Bell. (17) Jan. 4.
Heavy Electric Traction on the Continent. (17) Jan. 4.
Ninety-Tons Capacity Gondola, Norfolk & Western Ry.* (18) Jan. 4; (15) Jan. 3; (25) Jan.
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Mallet Compound Locomotives for the Missouri, Oklahoma & Gulf Ry.* (18) Jan. 4.
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Automatic Block Signals for Single Track; C., I. & L. Ry.* (13) Jan. 9.
An Industrial Locomotive Driven by a Crude Oil Engine.* (13) Jan. 9.
Side-Tank Locomotive for the Londonderry and Lough Swilly Railway Company.* (11) Jan. 10.
Locomotive Indicating Apparatus.* Hal. R. Stafford. (From *Loco.*) (18) Jan. 11.
A Critical Valve Gear Analysis.* (For Locomotives.) Geo. A. Hartman. (18) Jan. 11.
Jamaica Improvement of the Long Island Railroad.* (14) Jan. 11.
Block Signals and Interlocking Plants on the Chicago Great Western R. R.* (13) Jan. 16.
A 100-Ton Coal Car: Norfolk & Western Ry.* (13) Jan. 16.
Fuel Economy on the Rock Island. W. J. Tollerton. (15) Jan. 17.

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Electrification of Heavy Grades. C. L. de Muralt, M. Am. Soc. C. E. (15) Jan. 17.
Derailment of Trucks on Curves.* Arnold Stucki. (15) Jan. 17.
Force Feed Lubrication.* (15) Jan. 17.
The Measurement of the Steam Discharge from Locomotive Pop Safety-Valves.* (11) Jan. 17.
Pacific Type Engines for South Africa.* (12) Jan. 17.
Center-Entrance Interurban Cars for the Kansas City, Clay County & St. Joseph Railway.* (17) Jan. 18.
A Successful Automatic Train-Stop.* (46) Jan. 18.
Lighting Specification for Full Postal Cars. (18) Jan. 18; (15) Jan. 24.
A New Terminal Plan for Chicago.* (From *Railway and Engineering News.*) (19) Jan. 18.
Mikado Type Locomotives for the Illinois Central R. R.* (18) Jan. 18.
Fuel Economy on a Trunk Line Railroad.* W. B. Landon. (18) Jan. 18.
Electrification of Melbourne Suburban Railways. (18) Jan. 18.
Autoclave Test for Cement, D. L. & W. R. R. H. J. Force. (Paper read before the Engrs.' Soc. of Northeastern Pennsylvania.) (18) Jan. 18.
Water Flushed Rock Drills in the Mount Royal Tunnel.* (Abstract from *Mine and Quarry.*) (14) Jan. 18.
Newly Completed Union Station at Joliet.* (14) Jan. 18.
A Rail-Handling Machine for Rail Renewal.* (13) Jan. 23.
A Diagram Area of Railway Culvert Openings.* T. J. Wright, Jr. (13) Jan. 23.
A Collapsible Platform and Vestibule.* (15) Jan. 24.
Weighing Methods on the St. Louis & San Francisco. (15) Jan. 24.
Notes on Staking Out Track Connections.* W. H. Wilms. (15) Jan. 24.
Handling Track Material on the Pittsburgh & Lake Erie.* (15) Jan. 24.
Experimental Treatments, with Reference to the Effect of Initial Air Pressure on Penetration of Creosote. R. S. Belcher. (Paper read before the Wood Preservers' Assoc.) (15) Jan. 24.
Adzing and Boring Ties and the Cost of Installing Plants of this Kind. James A. Lounsbury. (Paper read before the Wood Preservers' Assoc.) (15) Jan. 24; (96) Jan. 30.
The Mercy of Steel and the Menace of Wood, a Study of Some Recent Railroad Accidents.* (46) Jan. 25.
A 1 200-Volt D. C. Line in Holland.* (17) Jan. 25.
A Comparison of Zinc Chloride with Coal-Tar Creosote for Preserving Cross-Ties. Howard F. Weiss. (Paper read before the Am. Wood Preservers' Assoc.) (17) Jan. 25; (18) Jan. 25; (15) Jan. 24; (14) Jan. 25.
Narrow-Gage Gasoline Cars for Australia.* (17) Jan. 25.
New Cotton Belt Freight Terminal at St. Louis. Winters Haydock. (18) Jan. 25.
The Question of Government Inspection of Rails. (Report of Committee, National Assoc. of R. R. Commrs.) (18) Jan. 25.
The New Canadian Pacific Railway Shops at Ogden, Alberta. (96) Jan. 30.
British Opinion on Railway Automatic Stops.* H. Raynar Wilson. (13) Jan. 30.
Grouting a Bank Revetment with Molten Slag.* (13) Jan. 30.
The Proposed Extension of the Grand Trunk Railway System in New England.* (13) Jan. 30.
A Continuous Rail.* (15) Jan. 31.
Locomotive Tender Derailments.* (15) Jan. 31.
The Use of Highly Superheated Steam. (For Locomotives.) Gilbert E. Ryder. (15) Jan. 31.
Electric Arc Headlight for Locomotives. John G. D. Mack. (From *Wisconsin Engineer.*) (19) Feb. 1.
Examen Critique d'un Mémoire, Considérations sur la Forme à Donner aux Coussinets de Boîtes à Huile et de Bielles de Locomotives. P. Raes. (31) Pt. 3, 1912.
Essais de Traction à Courant Monophasé, à 12 000 Volts, de la Compagnie des Chemins de Fer du Midi.* A. Bidault des Chaumes. (33) Serial beginning Dec. 28.
Sur un Moyen de Prévoir les Ruptures de Rails.* A. Mesnager. (Paper read before the Inter. Assoc. for Testing Materials.) (93) Jan.
Essai des Rails au Mouton quant à l'Allongement et la Ductilité du Métal. P. H. Dudley. (Abstract of paper read before the Inter. Assoc. for Testing Materials.) (93) Jan.
Recherches Américaines sur les Rails Poursuivies Conjointement par les Chemins de Fer et les Aciers.* H. Wickhorst. (Abstract of paper read before the Inter. Assoc. for Testing Materials.) (93) Jan.
Automotrices Pétroléo-Electriques Système H. Pieper. Marcel Hegelbacher. (33) Jan. 11.
1 F 1-Heissdampf-Tenderlokomotive der holländischen Staatsbahn auf Java.* Metzeltin. (48) Nov. 23.
Die Ausbildung der Lokomotivmannschaft bei den badischen Staatseisenbahnen.* Hefft. (102) Dec. 15.

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Ueber den Lauf steifachsiger Fahrzeuge durch Bahnkrümmungen.* K. Schlöss. (102) Dec. 15.
Ablaufanlagen auf Verschiebebahnhöfen für Eselsrückenbetrieb.* Cauer. (102) Dec. 15.
Die Lawinenverbauungen der Berner Alpenbahn Bern-Lötschberg-Simplon.* K. Imhof. (53) Serial beginning Dec. 20.
Scheitelhöhen ausgeführter und geplanter grosser Alpenbahnen.* (53) Dec. 27.
Der neue Oberbau der Wengernalpbahn auf der neuen Linie Lauterbrunnen-Wengen.* F. v. Steiger. (107) Dec. 28.
Richten eingedrückter Pufferbohlen und durchgedrückter Stirnwandwinkel an Güterwagen.* G. Rosenfeldt. (102) Jan. 1.
Zeichnerische Darstellung der Kräftewirkungen zwischen Rad und Schiene beim Befahren des krummen Stranges von Weichen.* P. Stadtmüller. (102) Jan. 1.
Die Hochspannungskabel der Wechselstrom-Bahnanlage Dessau-Bitterfeld; Verlegung, Betrieb und Versuche.* Leon Lichtenstein. (41) Jan. 2.
Die Baustoffe der Spurbahnen.* A. Haarmann. (50) Jan. 2.
Die elektrische Fernbahn Pamplona, Aoiz und Pamplona, Sangüesa.* (41) Jan. 9.
Die neue Personenschwebebahn auf dem Kohlererberg bei Bozen.* Ottokar Soulavy. (53) Jan. 10.

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Some Difficulties Encountered in Tunnel and Subway Construction in Boston.* Frederic I. Winslow. (28) Dec.
Utilizing Electrical Energy in the Construction of Subway at Boston.* (27) Jan. 4.
Grade Reduction on Street Railways.* Carl H. Reeves. (13) Jan. 9.
The Hamburg Elevated and Underground Railway.* (19) Jan. 11.
Electric Arc Welding on the Pacific Coast.* (17) Jan. 11.
Brooklyn Motor, Truck and Brakeshoe Improvements.* (17) Jan. 18.
A New Pay-Within Car for the Michigan United Traction Company.* (17) Jan. 18.
Baked Enamel Painting on the Cars of the Hudson & Manhattan Railroad.* (17) Jan. 25.
The Profitable Limit of a Five-Cent Street-Railway Fare. Henry G. Bradlee. (13) Jan. 30.
La Transformation des Réseaux d'Omnibus et de Tramways de la Compagnie Générale des Omnibus de Paris.* A. Bidault des Chaumes. (33) Dec. 7.
Nouvelles Voitures de Tramways du Système "Payez en Entrant." (33) Dec. 21.
Die elektrischen Stadtschnellbahnen der Vereinigten Staaten von Nordamerika; Anlage, Bau und Betrieb der Stadtbahnen in Neuyork, Boston, Philadelphia und Chicago.* F. Musil. (102) Serial beginning Jan. 1.
Zum Riesenverkehr in Weltstädten. Eugen Fassbender. (53) Jan. 17.

Sanitation.

To What Degree Must Sewage Be Purified? Chester G. Wigley. (59) Vol. 32.
The Main Drainage of Glasgow.* Alexander Beith McDonald and Gotfred Midgley Taylor. (63) Vol. 189.
The Construction of the Glasgow Main-Drainage Works.* William Cecil Easton. (63) Vol. 189.
Glasgow Main Drainage, the Mechanical Equipment of the Western Works and of the Kinning Park Pumping Station.* David Home Morton. (63) Vol. 189.
Daily Fluctuation in Sewage-Flows.* William Fairley. (63) Vol. 189.
Concrete Sewer Construction in Louisville.* J. H. Kimball. (60) Jan.
Operating Results of the Sewage Disposal Works at Bordentown, New Jersey.* C. M. Hartley. (86) Jan. 1.
Building of Brick Trunk Sewers.* Owen B. Maginnis. (76) Jan. 1.
Plumbing in a Tall Store and Loft Building.* (101) Jan. 3.
Cast-Iron Boiler Heating Plant in Skyscraper.* (101) Jan. 3.
Heating New County Court House at New Haven.* (101) Jan. 3.
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Sludge Disposal at Bradford.* (104) Jan. 3.
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Street Cleaning and Garbage Collection Methods in Chicago. (14) Jan. 4; (13) Jan. 16; (86) Jan. 18.
Sewage Disposal. J. Darlington Whitmore. (Paper read before the Regina Eng. Soc.) (96) Jan. 9.
Sewage Disposal by the Biological Process.* (101) Jan. 10.
Open Windows with Mechanical Ventilation. Ralph C. Taggart. (Paper read before the Am. Soc. of Heating and Ventilating Engrs.) (101) Jan. 10.
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Limiting the Use of the Chicago Drainage Canal. (13) Jan. 16.
Sanitary Equipment of a Loft Building.* (101) Jan. 17.
High Standard for Gymnasium Ventilation.* (101) Jan. 17.
The Hot-Panel and Hot-Floor Border System of Heating. H. Riall Sankey. (Paper read before the Junior Institution of Engrs.) (11) Jan. 17.
Seeing New York with the Sanitary Engineer. J. X. Cohen. (14) Jan. 18.
Construction of the Calumet-Sag Canal.* E. J. Kelly. (13) Jan. 23.
Drainage Area and Population of the Ohio River Valley and Pollution of the Ohio River. A. H. Horton. (13) Jan. 23.
Night Soil Incinerating Furnace at a Contractor's Camp.* Arthur W. Tidd. (13) Jan. 23.
Street Cleaning in Port Arthur. W. S. Bowden. (96) Jan. 23.
Temperature and Humidity in Factories. (101) Jan. 24.
Method of Locking Sewer Manhole Covers Employed at Webb City, Mo. E. W. Robinson. (86) Jan. 29.
Some Notes on Modern Sewage Pumping Machinery and Appliances, with Illustrative Examples.* (86) Jan. 29.
The Epidemic of Typhoid Fever in the City of Ottawa. Charles N. B. Canioc. (96) Jan. 30.
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